Nature Magazine

JANUARY
1955

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NUMBER 1

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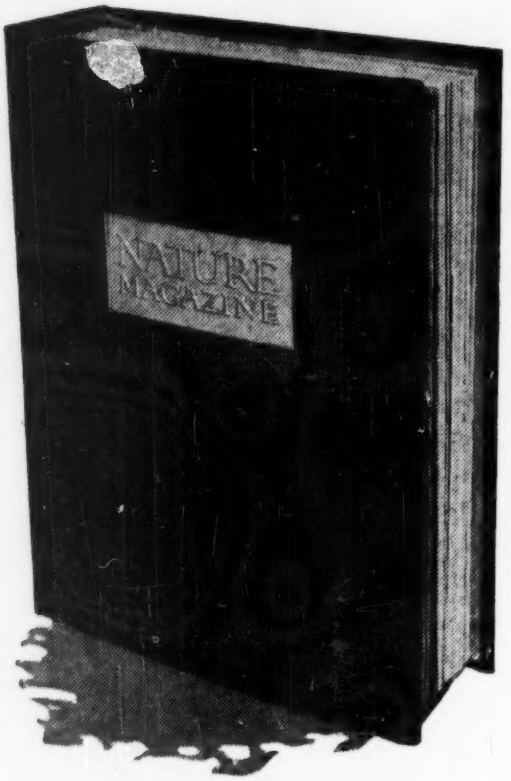

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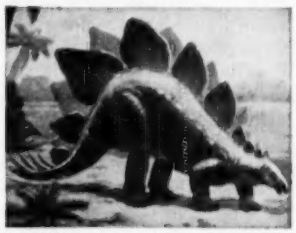

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Nature in Print

By HOWARD ZAHNISER

JANUARY brings with it annually a consciousness of the calendar, an interest in diaries and journals (which often also dies out with the month), and an impulse to reappraise our lives and our living and see how we can resolve to do better.

Mabel Louise Robinson—who lives in New York and teaches at Columbia University in the winter, but spends her weekends some forty miles up the Hudson and her summers in Maine—serves all these interests in her newly published almanac, *All the Year Round*. A slim volume, in large type, generously spaced, it is well designed to appeal to young readers (in their teens and older) as well as to the rest of us, and to stimulate interest in one's own journal.

"Get a small blank book at once," Miss Robinson suggests, "which you can keep with this all-the-year-round almanac. At the end of each week write in it the date and make your own entries about what you have observed during that week. Then at the end of the year, you will have your own almanac as well as mine."

The reader who thus perseveres and succeeds will indeed have something of interest and value, for Miss Robinson's almanac tells for each week of the year those happenings outdoors that seem outstanding, and she does this so interestingly as to provide a very good model. In the three pages for January's first week we read of snow, cardinals, whitethroats, the Pleiades, a hint of spring in a bird-like sound from burning branches in the fireplace, and a good-natured complaint about squirrels. She writes thus:

"A quick mole has moved into a hole over the rock outside the window. Gray and smooth as silver, he darts out for seed. He never learns that it is safe to be friendly, and perhaps he is right. He is small and defenseless. A tree sparrow picks up seeds on the same rock, and they pay no attention to each other. But let the squirrel come, and they all disappear. So does the squirrel as soon as I get after him!"

Thus, week after week, Miss Johnson compiles what she calls in her introduction "a kind of record of the universe," and shows how by keeping such a record we share the great sweep of the movement of the universe through the ages and "by our participation . . . share more deeply its growth, its changes, its meaning."

Edward E. Wildman, the retired director of science education in the Philadelphia public schools, has also enriched this New Year's opportunity with a newly published book that will inspire and help other would-be almanac makers. His work is, however, more of a guide in looking forward to each week; a suggestion of what to look for and how to understand it, rather than an example of how to record one's own week. Some years ago the president of the Shut-in Society of Greater Philadelphia asked the city's public schools superintendent to arrange a series of broadcasts in Nature study for the benefit of children not able to attend school. As a result Mr. Wildman (That is his real name, incidentally.) prepared a series of fifteen-minute broadcasts, one for each week. Later the broadcasts were printed in four seasonal booklets, and more recently, when the third edition of the booklets was gone, all were gathered into this book, entitled *This Week Out of Doors: A Nature Calendar*. Not only are its weekly "talks" filled with interesting facts, suggestions, and explanations but also the volume includes for each month a list of "Things to Do." For January thus Mr. Wildman suggests:

"Catch and observe some snow crystals on a dark surface. Identify and list the evergreen trees near your home. How can we easily distinguish a fir from a spruce tree? List six kinds of pines. How can we identify each? List a dozen things we do to avoid winter's hardships. Observe the 'new' moon. Why is it crescent? Why is the 'full' moon a disc? List some ways in which the snow helps animals. Plants. Make some paper pinwheels. List some ways that we can prove air pressure. Prove that water cannot enter a bottle full of air. List several ways that moving air makes sounds. Why do winds blow? List the causes of weather. Show that ice is lighter than water. List three winter harvests. Read Whittier's *Snow Bound*."

With Mr. Wildman's calendar to suggest activities and to point out possible observations, and with Miss Robinson's *All the Year Round* example of how she writes her weekly journal, we do indeed have a good pair of guides for an enterprise that is one of January's great allurements.

The records that others have kept, not only of the outdoors but especially of their own experiences in the outdoors, are among our chief aids in developing wise attitudes, and if Miss Robinson is correct in her belief that this kind of record "gives us the power to see long distances," and to measure up the importance of the various outdoor events "to us and to the rest of the living earth," we ought to read more of them, as well as keep our own.

Bill Geagan, an outdoorsman and conservationist of Maine, an author of a newspaper column who also makes a radio broadcast on the outdoors, is one of those who has written especially, as he himself puts it, "that others might find my wild world and enjoy it with me, tomorrow and tomorrow." His first book, which he entitled *Nature I Loved*, described his experience in being discouraged with himself in the city and then the good fortunes that came to him when he went to live a while in the Maine woods, there in another camp found his Alice, and came to realize his opportunity in telling others how they had "found the great outdoors with its wonders of Nature to be a glorious haven for the weary, the sick, and those broken under the cruel yoke of frustration, trouble, and taxes." In a new book (from which, in fact, these quotations are taken) Bill Geagan tells more of his experiences and this time uses the title *The Good Trail* to emphasize his hope "that others may follow and find, as we have found, another world."

This outdoor world, Bill Geagan points out, exists "everywhere across the land where the destructive and relentless march of man's so-called 'civilization' has not yet stamped it out." He writes, of course, of his own experiences, once again in the Maine woods, and this time centers all about his retreat to the woods to write the book, sharing thus with his readers his writing too, and adding as illustrations his own sketches. Thus he blazes a trail.

Bill Geagan realizes that few of the people for whom he is trail blazing can live in the woods away from "civilization," but he insists that "all can enjoy its blessings at intervals," and he assures them "they will find that such visits, be they ever so brief, will be as soothing balm to the traveler's tired feet and as pure, cold water to his parched throat."

So Bill Geagan blazes a trail to all the outdoor areas that still afford a retreat where we can find what he describes as "the beauty, peace, and contentment that God in the beginning intended." Christiane Ritter, after spending a winter on the Norwegian island of West Spitzbergen in the Arctic Ocean, has surmised that some will find in the Arctic the retreat from urban complexities and urgencies that so many seek. "Perhaps in centuries to come," Mrs. Ritter writes, "men will go to the Arctic as in Biblical times they withdrew to the desert, to find truth again." In the deep cold and darkness of an Arctic winter, in the midst of an aloneness that was sometimes absolute and at best was shared only by her husband and his trapping partner, Mrs. Ritter not only had the adventures with hardship, privation, and danger that give an excitement to her book, but she also perceived the appeal of this northern land and gained a perspective on the land she had left. It is an interesting and significant book.

Mrs. Ritter found the hunters and trappers of the Arctic to be "intoxicated by the vital breath of untamed nature, through which," she writes, "the deity speaks to them." One of the

Tonic

By JOHN F. DAVIDSON

"Tonic of wildness"
Thoreau terms our need:
Children of walledness
Our too common breed.

O that these fettered
(Mercy willing) might
Break from their shuttered
Cells to sweeps of Light.

interesting episodes she records is her attempt to save from the trappers with whom she lived the polar fox that came to their cabin, and one wonders how deep would be her resentment at the trapping of fur animals. She does confess that her dreams of one day owning a white fox fur have "vanished" and that, now she knows "what a live polar fox is like," she no longer wants "a dead one." Surely it is one of the perplexing ironies of truth and fact to note the trapping motive for these excursions during which "the deity speaks," yet the long residence in this land which our author finds so instructive does seem dependent on this destructive fur-trapping enterprise.

"You must live through the long night, the storms, and the destruction of human pride," Mrs. Ritter learns. "You must have gazed on the deadness of all things to grasp their livingness." With the persepective thus gained Mrs. Ritter realized "that civilization is suffering from a severe vitamin deficiency, because it cannot draw its strength directly from nature." She concludes that "humanity has lost itself in the unnatural and in the speculative." In her winter darkness she sees more clearly in all their brightness and color "the flowers and trees of the distant sun world" and sees, too, that "the people who live under the sun . . . are running round in circles, the circles of their anxieties and troubles." Only a few of the people she has left behind her in civilization "see the glory of the sun." In her loneliness, "in this apartness," she writes, "we develop a particularly sharp awareness of the mighty laws of the spirit, of the unfathomable gulf between human magnitudes and eternal truth."

Aside from her record of her own adventures and her representation to us of "the profound peace and the beauty of this gigantic wilderness of ice" it is Mrs. Ritter's speculations thus, on these magnitudes and eternal truth, that give her book its great value. We can not all of us live the life of Bill Geagan, and only a few can know the adventures of Christiane Ritter, but we all can at intervals spend some of our own lives in the natural surroundings that we still have. And through the writings of others we can share their longer experiences and deeper musings. If Mabel Louise Robinson's example and sampler and Edward E. Wildman's guide can help us in attending more closely and intelligently to the world of the outdoors that we do ourselves see, and in realizing the meanings that we perceive as we keep records through the cycles of seasons and years, they too will help us to profit the more from the experience of those who live longer in the wild lands and go to the still distant places of the earth. Perhaps in this direction lies a happier New Year!

All the Year Round. By Mabel Louise Robinson. New York: Harper & Brothers. 1954. 150 pp. (5½ by 8½ in.) with 13 line drawings by Aldren Watson on title page and at chapter heads. $2.50.

A Woman in the Polar Night. By Christiane Ritter. Translated from the German by Jane Degras. New York: E. P. Dutton & Co. Inc. 1954. 223 pp. (5½ by 8¼ in.) with 24 line drawings in the text and frontispiece map by the author. $3.

The Good Trail. By Bill Geagan. New York: Coward-McCann, Inc. 1954. 237 pp. (5½ by 8¼ in.), with introduction by United States Senator Margaret Chase Smith and 26 chapter-head drawings by the author. $3.50.

This Week Out of Doors: A Nature Calendar. By Edward E. Wildman. Narberth, Pennsylvania: Livingston Publishing Co. 1954. 202 pp. (5⅛ by 8 in.), with three text drawings and index. $2.75.

Flowering Cactuses

The Flowering Cactus. Edited by Raymond Carlson. New York. 1954. McGraw-Hill Book Company. 96 pages. 115 photographs, 81 in color, by R. C. and Claire Meyer Proctor. Sketches by George M. Avey. $7.50.

Here is a book of breath-taking beauty, magnificently illustrated with color plates showing more than eighty flowering species of cactuses in full and startling bloom. Nowhere else has there been gathered a comparable display of colored pictures of these species that help make the desert bloom. The editor is also editor of *Arizona Highways.* The text describes popularly the various species pictured, and also provides information on the care of propagation of cactuses. A map shows the location of the different species in the Southwest.

Campcraft

Handbook of Trail Campcraft. Edited by John A. Ledlie. New York. 1954. Association Press. 187 pages. Illustrated. $4.95.

This practical book for the outdoorsman has been prepared by the National Campcraft Commission of Young Mens Christian Associations. It is a guide to basic equipment needs, tools and shelters, direction finding, canoe trips, winter camping, fire building and cooking, health and safety, leader training, and complete hiking know-how. It is a collaboration by sixteen educators and outdoorsmen.

Demand for Wood

America's Demand for Wood, 1929-1975. Tacoma, Washington. 1954. Weyerhaeuser Timber Company. Illustrated.

This is the summary of a report made by the Stanford Research Institute of Stanford, California, to the Weyerhaeuser Timber Company. It considers the drain upon our wood resources since 1929 and looks forward to the likely demands between now and 1975. Charts and tables supplement the direct text; together they graphically present a story of basic importance.

NATURE MAGAZINE

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To Stimulate Public Interest in Every Phase of Nature and the Out-Of-Doors, and Devoted to the Practical Conservation of the Great Natural Resources of America

IN THIS ISSUE

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Mammal Guide

The Mammal Guide. By Ralph S. Palmer. New York. Doubleday and Company. Illustrated in color and black and white by the author. $4.95.

This is the latest addition to the guide series being brought out by this publisher, and an excellent addition, too. The author is State Zoologist in the New York State Museum and State Science Service in Albany. Distribution maps accompany the descriptions of the mammals, their habitats, reproduction, and habits. It is a book that is national in scope and contains 250 subjects shown in full color. It is written for use by the layman.

Minnesota Ferns

The Ferns and Fern Allies of Minnesota. By Rolla M. Tryon, Jr. Minneapolis. 1954. University of Minnesota Press. 166 pages. Illustrated by Wilma Monserud. Paper, $2.75; cloth, $4.00.

Although excellent guides to Minnesota flora have been published they appeared so long ago that they are today available only in libraries or through dealers. Also, botanical knowledge has moved forward in the interrim. This guide seeks to fill a gap in available literature on the ferns and fern allies of Minnesota, and will find ready welcome.

Nut Trees

The Improved Nut Trees of North America. By Clarence A. Reed and John Davidson. New York. 1954. The Devin Adair Company. 404 pages. Illustrated. $6.00.

In this book the most up-to-date information on the varieties of nut trees and important hybrids and importations is provided. Cultural practices are set forth, and the authors seem to have included everything pertinent to nut trees and nut tree growing in the United States.

Climate

Climatic Atlas of the United States. By Stephen S. Visher. Cambridge, Mass. 1954. Harvard University Press. 403 pages. $9.00.

The 1031 maps and diagrams in this book are presented in 34 chapters grouped in seven parts. Five parts embrace the major elements of climate: Temperature, wind, sunshine, humidity, and precipitation, and the other two, some consequences of climate and weather, and climatic regions and climatic changes. The consequences include those to agriculture, health, soil erosion, soil moisture, soil freezing, lakes, streams and topography. The part on climatic regions is a notable collection of 48 maps of climatic regions or zones, based on a great variety of criteria. The presentation of climatic change includes a number of diagrams showing annual sequences, in some cases for one hundred years or more. This volume is, indeed, an outstanding contribution to meteorological literature.

W. H. Hudson

From Pampas to Hedgerows and Downs. By Richard E. Haymaker. New York. 1954. Bookman Associates. 398 pages. $5.00.

Recognized then as one of the great contributors to the literature of the outdoors, W. H. Hudson passed away in 1922. Since that time his position has been increasingly appreciated. However, since his death, only one critical study of his work—at least only one truly comprehensive study—has appeared. Now Mr. Haymaker gives us a splendid estimate of Hudson and of his writings. He is convinced that Hudson is entitled to place along with White and Thoreau. Mr. Haymaker's work is scholarly but it is not exclusively for the student of Hudson, but for anyone who appreciates him.

Guide to Tracks

A Field Guide to Animal Tracks. By Olaus Murie. Boston. 1954. Houghton Mifflin Company. 374 pages. Illustrated by the author. $3.75.

This latest addition to the fine Peterson Field Guide Series has been anticipated for some time, at least by those who have known that it was in the process of preparation. One of the country's leading mammalogists, and a man whose extensive field knowledge of animal tracks is probably not exceeded, Olaus Murie provides us with the most complete and authoritative work on this Nature subject since the works of Seton. Here is a guide to the animal you did not see; an introduction to the animal through its field marks, which the author and artist himself recorded from the tracks themselves as seen outdoors. Drawings of the droppings of the animals are also supplied as further guide to identification, and the illustrations and text indicate what the animal was doing when he left his sign of passage or action. Based so largely on his own experience afield, the text is exceptionally readable, and the guide is usable by the layman just as much as it is by the specialist. Here is a distinguished addition to an outstanding series of Nature guides.

Waters

Streams, Lakes, Ponds. By Robert E. Coker. Chapel Hill. 1954. University of North Carolina Press. 327 pages. Illustrated. $6.00.

One of our most valued national possessions is represented by our inland waters, the life they support and the part that they play in our lives. The story of these waters is a complex one, fascinating in its complexity. Streams, lakes and ponds are of concern to a variety of specialists—sanitarians, engineers, ecologists, conservationists, industrialists, agriculturalists and others. They are also of vital concern to the lay individual. Dr. Coker, who is Kenan Professor of Zoology at the University of North Carolina, has written this book for all of these, including the layman.

Seasoned with Salt

Seasoned with Salt. By Mary Travis Arny. Philadelphia. 1954. The Westminster Press. 230 pages. $3.50.

"This is the story of a house and of those who have lived, laughed, and loved in it," says Mrs. Arny in a prefatory note. That leaves it for the reviewer to add that it is a warm and wholly fascinating story of that house and those who dwelled therein. Father was a preacher but no ordinary one in thought or action. Mother was a "sweetheart," with some dashes of Mrs. Clarence Day in her makeup. All the others who appear on the pages of this book are worth meeting and treasuring. As we read we see how the author developed as a naturalist, for she is an authority on seed pathology and possesses a catholic interest in Nature generally. She writes with great charm and is an accomplished reporter. Here, indeed, is a delightful book.

History of Birds

A History of Birds. By James Fisher. Boston. 1954. Houghton Mifflin Company. 205 pages. $3.75.

This is a book designed for university students in natural history, ornithology and ecology. It starts with the earliest known ornithological records from the Old Stone Age, as recorded in the caves in France, and proceeds through the centuries as bird knowledge grew. This is a most valuable and interesting contribution to ornithological literature, and one, we believe, that has no counterpart.

Insects

Freaks and Marvels of Insect Life. By Harold Bastin. New York. 1954. A. A. Wyn, Inc. 248 pages. Illustrated. $3.75.

This book is at once a popular introduction to entomology, and an assembly of information about interesting insect forms, as well as a presentation of some of the unsolved mysteries in the world of insects. The author is a life-long student of insect life and an able writer both of scientific and popular material. His treatment here is popular.

Bafut Beagles

The Bafut Beagles. By Gerald M. Durrell. New York. 1954. The Viking Press. 328 pages. Illustrated by Ralph Thompson. $3.75.

A young zoological collector, the author of this interesting book first told of his experiences in his popular and recent *The Overloaded Ark.* Now he gives us a sort of sequel. Bafut is a great grasslands kingdom in Africa, ruled by the Fon of Bafut. This headman organized a group of his subjects to help Gerald Durrell in collecting local fauna. This collaboration resulted in experiences and some untoward events that make fascinating and entertaining reading.

Contents Noted

RECENTLY we have read and heard quite a bit about "windfall profits" in housing deals. Percentages of profit compared with investment have often been fantastic. However, Dr. Paul Bartsch of our Scientific Consulting Board tells us that he has demonstrated an investment that makes the publicized housing shenanigans look conservative. Dr. Bartsch lives at "Lebanon," his country place some twenty minutes from the national capital, where, of course, birds are invited guests. Two years ago the Bartsches purchased 800 pounds of sunflower seeds, these being greatly relished by many evening grosbeaks. Last year several flocks of purple finches and other seed-eaters were regular winter boarders, eating seeds raised from sunflower planting. During 1954, Dr. Bartsch increased his planting of sunflowers, and, being a scientist and thus curious, counted the seeds in one of the larger sunflower heads. They numbered 2085, which is a 2085 percent return in the investment of one seed. He thinks this makes the windfall operators rather "small potatoes," and he urges everyone who has a place along a fence to invest in sunflowers and thus provide ample winter food for avian visitors.

AFTER the 83rd Congress had gone its way, failing to give approval to the proposal to build a great dam in Dinosaur National Monument, some conservationists blithely announced that the victory was won. While we, of course, recorded the fact, we did not suggest that the fight is over. In the language of fisticuffs, conservationists merely won another round, of which there have been several in the "title fight" against Echo Park Dam. Now, after the usual between-rounds rest, they must get back on their feet and fight some more. The invasion of Dinosaur will be quickly back in the new and 84th Congress. Proponents of the Upper Colorado Storage Project, including Echo Park Dam, are prepared to make an even more determined drive for success. More funds will back this drive, as witness the decision of the Upper Colorado River Commission to open a Washington office, prepare a documentary motion picture and print brochures. Appropriation was also made for newspaper publicity. It is thus evident that the conservation forces, opposing Echo Park Dam as a dangerous precedent because of its exploitation of a National Park Service area, will have to stay in there and punch. Winning one round, or even several rounds, does not win a fight because a knockout blow is always possible.

ONE of our members wrote recently to ask whether we thought that conservation issues had anything to do with the change in the personal membership in, and political complexion of, the 84th Congress, We think it was one factor in many of the contests for Senator and Representative. It could even have been a deciding factor in some of the close races, of which there were many. During the past year, or more, considerable attention has been focused on an undeniable tendency of the present administration to lean toward exploitation of our national park, national forest and other public lands for the benefit of private interests. We do not say this in a partisan sense, because we firmly believe that conservation is a nonpartisan ideal. Nevertheless, we are convinced that many people distrust such a trend. Visitors to our National Parks, recreational users of our National Forests, supporters of our National Wildlife Refuges constitute a considerable percentage of our people. They are voters, too, and as such naturally scan the record of candidates on conservation issues, and vote accordingly.

NOT unrelated to the words above is the announcement by the U. S. Fish and Wildlife Service that the calendar year of 1953 showed a record use of the 272 National Wildlife Refuges under the administration of the Service. There were 4,686,909 visitors to these areas, an increase of more than 400,000 over the previous year. More than one third of these visitations were for fishing, while public hunting showed an increase. Visitation merely to observe the wildlife inhabiting the refuges also showed a rise, and accounted for a substantial percentage of the use of the areas. There has been a gradual increase in the recreational facilities available on the refuges, and this will undoubtedly grow, although the primary purpose for which the areas were established will be, or should be, always the controlling factor. But the fact remains that more and more people use and value the refuge system and stand for its preservation.

ALSO action not unrelated to the trend we have noted is to be found in revised Civil Service Commission classifications. In the Government there are certain positions of responsibility that can be called "career jobs." These call for specially qualified individuals, often with scientific backgrounds, who devote their lives to the public service. Such individuals have been protected by being in what is known as "Schedule A." Some of these career posts have been transferred to "Schedule C," thus making the officials subject to replacement for political reasons. Top officials in the U. S. Fish and Wildlife Service, the National Park Service and the Soil Conservation Service have been placed in this classification. Experience, competence, scientific ability and dedication to the purposes of the agencies involved have been the measure of the individuals who head them, not how they vote, if, indeed, in voteless Washington, they vote at all. Making career posts vulnerable in this fashion is bad business, and, we think, bad politics. We repeat, conservationists vote. R.W.W.

Embraced by the dense sand pine forest are frequent sunlit "prairies" decked with many gaily colored flowers. No trees encroach upon these savannas in Florida's Ocala National Forest, but they are fringed by slash pines and palmettos.

Florida's Suicidal Forest

By GEORGE S. WELLS

U. S. Forest Service Photographs

JOHN J. Olson, stocky and genial ranger who cares for our southernmost national forest, needs and uses more tact in his job than perhaps any other forester in the nation. For his charge, the National Forest known as the Ocala, probably attracts more recreation-seeking visitors per acre than any equivalent patch of wilderness known.

But behind a smile, Olson's trademark to all who know him, there is the faint suggestion of a frown. Press him for the reason and he may tell you, "It's the sand pine."

This enigmatic statement causes the average visitor to stare. It is, however, fraught with meaning for some of the country's top silviculturists, who share with the ranger a deep frustration over the misbehavior of his forest. For the sand pine to which he refers is the only forest of its kind in the world—and it is slowly but surely committing suicide.

The curious predilection of the trees that make up nearly half of the Ocala's 360,000 acres is quite enough to set the place apart. Yet, it is only one of a list of unique characteristics of the area.

For instance, the streams of the Ocala are fed by hot springs, gushing forth water of a never-varying temperature into basins of pure white sand. So brilliantly clear is the flow that you can read the stamped words on a penny that lies several feet under water.

Scattered throughout the forest are strange winding meadows, called prairies, lush with grass and filled with water lilies floating on shallow lakes, which form where the land dips below the water table. Beyond their slash-pine fringes grow thick stands of sand pine, broken in turn by the unexplained phenomena called "islands." These are higher ground on which only one particular kind of tree will grow, and so sharp is their separation from the surrounding forest that you cross a "type line" in a single step.

Deer in the Ocala forest breed and drop their fawns the year around, without regard for season, and a herd of about 5000 reproduces at a rate of about twenty-five percent a year.

In the lowlands, which are veined with streams and filled with more than two hundred interconnecting lakes stocked with black bass, the pine

The Oklawaha River, forming the western and northern boundaries of the forest, offers wilderness adventure for the canoeist and outboard motor enthusiast. Deserted landings provide handy campsites throughout this almost uninhabited country.

Forest officials examine a typical stand of sand pine that is almost ready for harvesting. Note the heavy deadfall from the forest's natural weeding-out process.

stands give way abruptly to rank jungle growth. At least it looks like jungle at first glance. Look closer and you will find an incredible mixture of maples standing next to crimson-flowering yaupons; graceful coconut palms leaning to brush their fronds against gray cypress knees. All the forests of the eastern seaboard seem to meet here on equal terms along the lukewarm creeks.

It is a fascinating experience to accompany Ranger Olson on a jaunt through his domain, since the most dramatic sights are ranged in convenient succession within the Lake George section that he administers.

This is the part lying north of Florida highway 40, which bisects the forest on its path across the peninsula from the city of Ocala to Daytona Beach. The western boundary of the section is a wilderness river called the Oklawaha, lying just outside famed Silver Springs and lined with moss-hung cypresses and crumbling landings left from the early influx of pioneers.

The river curves around to form the northern border, then connects with Lake George and the St. Johns River, which is the eastern boundary. Within this horseshoe circlet of water is the principal stand of sand pine, along with island groups of longleaf, pond pine, loblolly and slash.

No matter where you start your tour with Olson, you almost surely will end within the sand pine. For this recalcitrant tree is always on his mind. It is, as he says, in marvelous understatement, "a problem."

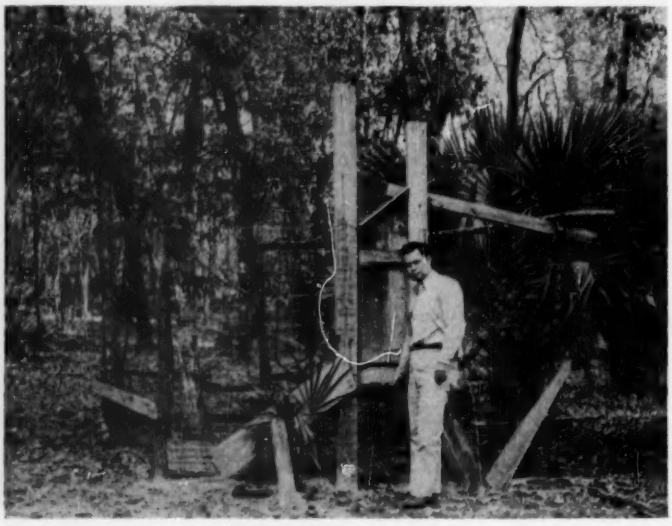
Its appearance belies its obduracy, however. It grows thickly, in even-age stand, rooting itself in porous sand where no other pine will grow. Little underbrush impedes it; each tree seems healthy and richly green, waving delicate needles in a filigree pattern against the sky.

"But," says Olson sadly, "when the sand pine nears maturity, its bark becomes almost explosive, so that any spark will set it off."

Inevitably, you look at the bare sand and wonder how it could burn. Then Olson adds, "The fire always crowns. And it burns as though it were soaked in gasoline. We had a fire on the other side of the road some years ago and, in a stiff wind, it spread at the rate of five acres a second. You couldn't hope to stop it."

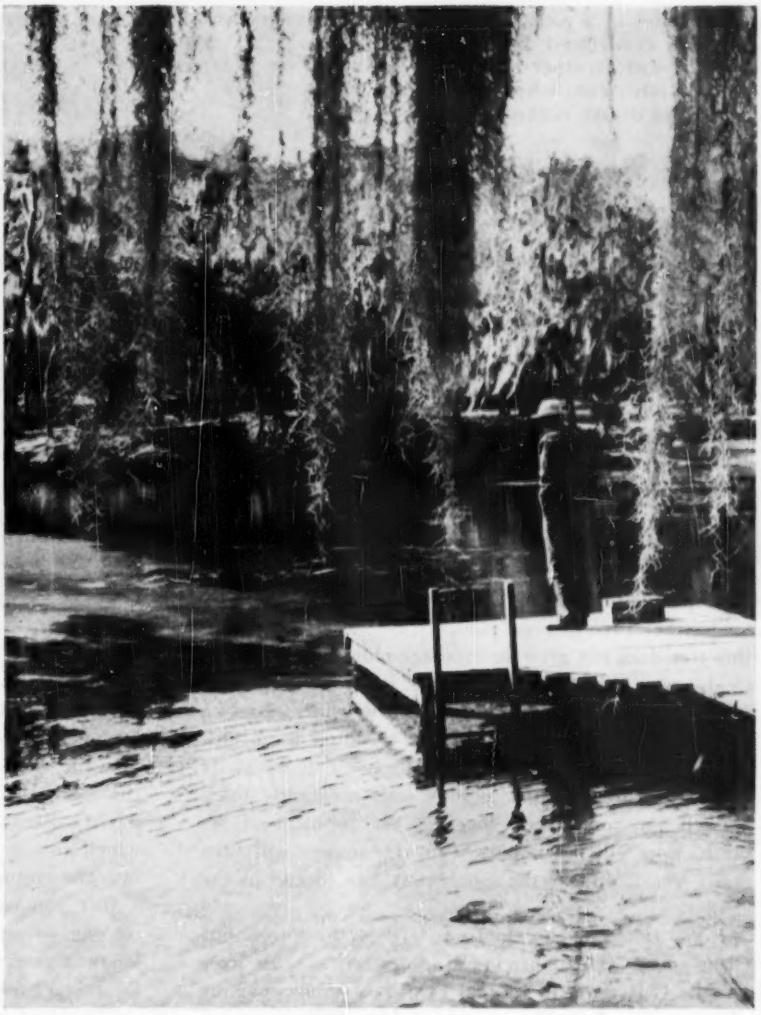
Nature's reason for such ill behavior, it turns out, is that the cone of the sand pine is so persistent that only in the intense heat of fire will it drop and open to release the tiny seed. This is why it is called *Pinus clausa*, the latter word meaning closed.

Those few cones that fall without fire cling with



Among Ranger Olson's problems are wild pigs. He stands beside one of his home-made traps, in which the pigs are caught. They are turned over to local farmers.

Cypresses and live oaks, festooned with Spanish moss, encircle the clear waters of Silver Glen Springs in Ocala National Forest in Florida.



equal tenacity to their seeds, which remain viable as long as five or six years. Thus, the forest literally must commit suicide in order to reproduce itself.

And there is another destructive fact about this tree. In the burned-over area across the road, in the province of Ranger W. H. Croke, who handles the southern portion, the sand pine is growing back so thickly that it chokes itself. "It may take half a century for it to grow back enough for use as pulp," says Olson, "whereas, if we could thin it out, we'd have a useable stand within thirty years."

Thinning, however, is too expensive, in view of the price of pulp. So unless the Forest Service is able to develop use of young sand pine for things like Christmas trees or broom stalks, the forest will continue to inhibit itself and, in a subtler way than by fire, commit suicide.

Until unusually heavy demand for pulp wood followed World War II, the Ocala was a forgotten wilderness, left strictly alone except for custodial care and the cutting of the sand pine into five-acre squares—the only means of controlling fire. The wood was not known to the trade, since *Pinus clausa* is known to grow nowhere else in the world, except for a small stand in Baldwin County, Alabama, and scattered clumps elsewhere.

But, in 1948, the harvesting began. Loggers came in with equipment specially built to operate in shifting sand and hauled out pulp along the fire roads. They had to cut brush and grind it into the sand in order to make a road. And they had to devise an economical way of cutting, using a rotary gasoline saw on a wheelbarrow base. One swipe on either side and a tree was down. But the loggers left unwanted trees standing as sentinels over the waste. This was the first difficulty for Olson, since the sand pine is most easily grown in even-age stands. He was destined, however, for many more headaches.

For example, wherever the sand pine was cut, the ground lay bare. Cones littered the soil, but without a fire they would not open. So the foresters tried burning. Results were less than nothing.

They laid brush across the ground, then devised a special harrow and disker to cut it into two-inch bits and thrust the whole mess into the sand, where the sliced-open cones might drop their seeds to germinate. Results were only fair. They planted hundreds of thousands of carefully nurtured seedlings, discarding machine planting as too uncertain and spending heavy sums on manual operation.

These plantings have been watched with great care. For three years an expert worked over them, but when he left a short time ago his report was not too hopeful. The forest had to be used, in accordance with firm and long standing policy. But it was destined to ultimate ruin as the ground lay empty after every cutting?

This prospect was especially aggravating after silviculturists came in on the coattails of a fire and found an incredibly high seed count in the sand. The seed fall began in a matter of hours after the blaze, and at the end of three weeks they counted 1,092,000 seeds per acre, when only 1000 were needed to reproduce the stand.

Determined to find some way to save the estimated 35,000 cords of pulpwood that the Ocala can produce

Recreation is a part of the service rendered by the Ocala, as at Juniper Spring Recreation Area, which attracts many visitors.

each year with normal regeneration, the experts finally came up last year with what may turn out to be the solution.

Along the Choctaw River in western Florida they located a close relative of the sand pine; indistinguishable, in fact, except for one salient characteristic. The tree had open cones.

Tentatively named the Choctawhatchee race of sand pine, this tree does not grow in even-age clumps as does the Ocala race. But it regenerates itself without fire. As a result, Olson has planted, on Riverside Island in his Lake George section, groups of seedlings from both types of pine. If the Choctawhatchee can be made to grow in the Ocala's porous soil, in stands thick enough for commercial logging, the problem of reproduction will be solved. But the answer will take many years, and at the moment it lies locked in the sands.

Pinus clausa is the chief mystery of the forest, but Olson says: "This place is full of mysteries." He likes to take visitors up to Juniper Prairie, a sinuous avenue of openness where the grass is golden yellow against the dark water of central pools, and where great open savannas remind you instantly of the prairies in central Africa. "This," Olson likes to explain, "is what I call my lion country."

You do, indeed, look instinctively for lions to pad out from behind the rocks and hummocks. But all you see are kingfishers standing guard, shy deer at the shadowy edge of the forest, and great blue herons lumbering like bombers across the water.

Another of Olson's favorite spots is Pat's Island, named for Pat Long, who farmed there and lies buried with his family in a tiny, iron-fenced grave plot in the middle of the woods. Nearby is Pat's sinkhole, a depression more than 100 feet deep where the land suddenly gave way. There are many such breaks in the Ocala's limestone crust, some so abrupt you cannot see them until you are about to step over the edge.

Nathan Byrd, the junior forester who assists Olson, is a good man to go with into the sand pine forest. He will show you, for instance, the delicately beautiful deer moss that carpets the ground with aquamarine. "We cut it into shapes and use it for Christmas ornaments," he says. "The local people sometimes collect, clean it, and sell it for ten dollars a pound."

Byrd seems to love the sand pine as a gardener loves his plants, and his eyes gleam with pride as he shows you the rich harvest that loggers are removing from the interior of Ocala Forest, and points to the careful job of cultivation that is being done with the "chopper," which goes in after the cut is made to grind the slash into the ground.

But you cannot travel long on the Ocala without coming to an island, and then you learn about the longleaf pine, which has almost as tough a time as its diminutive neighbor.

"Longleaf produces a good crop of seed only about every three to five years," Byrd may explain. "And, like the sand pine, it just hates to let go. So we have to study the crop. When it's good, we pick the perfect day and go along in jeeps with torches to set fire to the forest."

Because longleaf is an open forest and trees are tall and difficult to burn, the fire creeps along the ground. It burns the underbrush and grass, the heat opens the cones and the seeds are released to take root.

Much easier to manage is the slash pine, which in several cut-over areas is growing back strongly without aid. Pond pine and loblolly also are without the sand pine's self-destructive tendency and offer few problems except where old cuts were so complete that scrub oak and sweet bay moved in to choke the seedlings.

A forest is not all trees, of course. And the animal life of the Ocala is interesting, too. For instance, the place has many armadillos, those armor-plated creatures that made their way from Texas to settle in the Sunshine State. With pig-like snouts, long flapping ears and ratlike tails, (Continued on page 50)

The well-known Sung dynasty painter, Chao Meng-chien (A.D. 1199-1295), "wrote" these three plants of narcissus amidst blades of grass, which recall the legendary origin of the "water fairy flower." Courtesy, Freer Gallery of Art.

To Welcome the New Year

By MABEL IRENE HUGGINS

WHAT would Christmas be without holly and poinsettias? Just as firmly established in the traditional celebrations of another day on the calendar, we find the "water fairy flower," the "heavenly bamboo," the "Buddha's hand," and the plum blossom. Through the passage of the years in China, this quartet has had great importance in welcoming the lunar New Year.

Narcissus tazetta var. *orientalis*, known to the western world as the Chinese sacred lily, is called ***shui hsien hua*** in Chinese. It is the "water fairy flower," a name that suggests its legendary origin.

Long, long ago near the city of Changchow in the province of Fukien, there lived a poor widow and her ten-year-old son. Although still only a small lad, he was criticized by his mother for spending his days in nothing but play while she drudged away long hours with incessant needlework in order to earn a living.

Late one afternoon a wretched old beggar came beating on the widow's humble gate. "*K'o-lien, k'o-lien wo*, pity, oh pity me," he wailed. The woman kept right on with her work, calling out, as she did so, that they were poor and had nothing to spare from their larder.

But pity prevailed in her heart and before the beggar had gone more than a few steps, the woman ran to her gate and said, "Come back and I shall give you the rice that I was saving for my worthless little boy." Soon the old beggar was eating the warm rice and a bit of salt vegetable with real relish. Having finished, he thanked the woman for her goodness and started on his way.

Nearby there was a plot of grass adjacent to one of the village ponds. As the beggar loitered on the grassy plot he spat out the rice which he had so recently eaten. Before long the woman heard a loud splash in the pond. She ran to look, but nowhere was the beggar to be seen. The villagers dredged the pond in an effort to recover the body but to no avail. What had become of the old man nobody

The "water fairy flower" and plum blossoms were appropriately combined by the contemporary painter, Sun Sung Chao, who painted the scroll "at the coldest time of the year." It was used to carry New Year's greetings. From the collection of Laura B. Cross.

Amber and jade were used in developing this realistic "Buddha's hand" tree. Courtesy, Mrs. Joseph E. Davies.

Rare beauty was attained by an ambitious craftsman who included all four of the New Year's plants in this jade-tree. It is one of a pair, formerly in the Imperial Palaces, Peking. Beneath the plum tree is a "Buddha's hand" sapling, right, and at the left may be seen a bush of "heavenly bamboo" as well as a "water fairy flower." Courtesy, Mrs. Joseph E. Davies.

could say.

Next morning when the poor widow rose to begin another day's toil, she looked out her gate toward the pond, the scene of the recent tragedy. To her surprise all over the grassy plot there were growing stalks of fragrant, snowy white flowers where the old beggar had spat out the rice. Then it was known that the miserable old man had been a fairy in disguise, and that he had taken this way of thanking the woman for her kindness. This, according to the legend, was the origin of the Chinese sacred lily, and from that time the fortunes of the widow changed for she made her living by selling lily bulbs.

At any rate, the Chinese sacred lily is an important product of Changchow where the ones of finest quality are reputed to grow. It was in that region of China that the wild form was discovered.

It is the custom to plant the bulbs in glass or porcelain dishes filled with clean pebbles and water. The Chinese have a skillful way of cutting a gash into the side of the bulb without damaging the undeveloped flower buds, so that when the bulbs are forced into bloom, the leaves are stunted and curl around the rather dwarf blossom-stalks. They are grown in the dead of winter especially for the Chinese New Year festival, and it is thought that they bring good luck for the following year if the flowers open exactly at the New Year. To the Chinese the fragrance of the water fairy flower is a special favorite and is spoken of as bringing the same delight as that of the cassia and the orchid.

As long ago as the Sung dynasty (A.D. 960-1279) Chinese painters were using the narcissus as the subject for their paintings. A fine example from that period is the scroll by Chao Meng-chien (A.D. 1199-1295) which is one of the treasures in the Freer Gallery of Art in Washington, D.C. The leaves required the same skillful execution as was necessary in writing Chinese characters, and therefore afforded the painter a genuine challenge. This motif is also noted in embroideries.

At one time considerable quantities of Chinese sacred lily bulbs were imported into the United States. How-

ever, restrictions on the importation of these bulbs became necessary as a result of serious disease and insect infestations from which the United States found it necessary to be protected.

The second plant that the Chinese like to have at New Year's time is the "heavenly bamboo." In Chinese its name is *t'ien-chu*, which literally means "heaven bamboo," a term that is botanically incorrect inasmuch as the plant is not a bamboo at all, but a genus of the family *Berberidaceae*. The plant is native both to China and to Japan. In the latter country it is called *nan-ten*, "south heaven," and it is from this term that we have the scientific name of the genus, *Nandina*. Its only known species is *N. domestica*, which the Chinese prize for its great bunches of bright red berries, their color being indicative of good luck.

Nandina domestica is an evergreen shrub with graceful foliage of compound leaflets, bronzy red when young, dark green at maturity, and changing to beautiful coppery red or purple tones in winter. Clusters of tiny white flowers are followed by large terminal spikes of vivid scarlet berries, which are retained until the following spring. The shrub grows to heights of five to ten feet.

That the species was in cultivation in England before 1808 is indicated by the publication of a plate in *Curtis's Botanical Magazine*, vol. 27: *pl. 1109* (1808), with the statement that a flowering specimen was taken from the greenhouse of "Messrs. Lee and Kennedy." The date and circumstances of its introduction into the United States seem uncertain.

In America *Nandina domestica* is hardy to Washington and on Long Island and it has become a favorite in California gardens. Its popularity is well-deserved as it is highly decorative all the year. It can be obtained in almost all nurseries in California and in the South.

Embroidered "heavenly bamboo" and a rose bush shelter a group of quail. From the collection of Alice C. Reed.

In North China where the winters are cold, florists raise it as a potted plant in order to be able to provide it to their patrons at New Year's time when they want the bright red, good-luck berries in their homes.

We are not surprised that the heavenly bamboo, with its showy berries and attractive foliage, was another favorite of Chinese painters. In *Chinese Free-Hand Flower Painting* by Wang Fang-Chuen, the author listed *Nandina domestica* amongst "the most popular flowers, trees, vegetables, and fruits, which are used as subjects of painting." Skilled craftsmen of the lapidary's art found that delightful likenesses of the berries and leaves of *Nandina domestica* could be fashioned from coral or carnelian and jade. Embroideries likewise recorded the popularity of this motif, which was also used occasionally in the decoration of porcelains.

Under the imperial regime in China, the height of ambition was for official promotion. The scholar who passed the old-style examinations had his chance to get on in the world by means of appointment to high official position. It seems but natural, then, that the Buddha's hand, *Citrus medica sarcodactylus*, symbol of official promotion and wealth, should have had a place in the Chinese New Year's celebrations. This peculiar fruit of finger-like divisions was arranged on saucers and placed on the household altars at this season—an expression, as it were, of a hope for advancement in the New Year. Under the present government such superstitious procedures have doubtless been frowned upon and discontinued.

The Buddha's hand is cultivated as a potted plant similar to dwarf lemons and oranges, and is pleasing to the Chinese not only for its decorative effect but also for the fragrant odor of the fruit.

As one of the "three abundances," the Buddha's hand was an extremely popular motif in Chinese arts and crafts, where it was used in paintings, embroideries, jades, ivory carvings, metal work, and on porcelains and lacquer.

However, there are numerous examples of the Buddha's hand used independently of the other members of the "three fruits." Porcelain teacups, ivory snuff bottles, small decorative objects of carnelian or jade were made in the form of this unusual fruit. Far more ambitious was the craftsman who made a pair of dwarf Buddha's hand trees skillfully wrought from jade and amber into a lovely object of art.

The fourth member of the Chinese New Year's quartet is the flowering plum, the *mei-hua*, which grows wild in some parts of China. It is the emblem of winter and one of the numerous symbols of long life. Its dwarf cultivated form is trained by clever twistings into the potted specimens that appear in the florist shops and flower markets to be sold as New Year's decorations. The flowering plum, or *prunus*, is not only the symbol of winter but it is also the harbinger of spring.

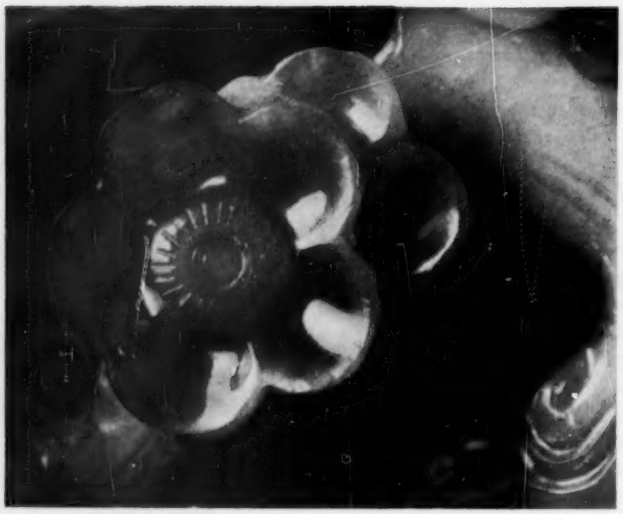
The prunus pattern became familiar to the western world through the blue and white jars that were erroneously called "hawthorn jars." Such jars were used to contain gifts of fragrant tea or preserved fruits at the New Year, so it was only appropriate that the decoration be the plum blossom, floral emblem of the season. Sometimes the design represented ascending branches; sometimes the branches were descending; sometimes only groups of flowers were shown; sometimes the prunus flowers were interrupted with panels of varying forms in which were portrayed some of the "hundred antiques" or landscapes.

Although the plum blossom enjoyed great popularity as a design in ceramics, it had even a greater appeal to painters. Some specialized on it, spending their entire lives trying to master the art of showing it in all its forms.

Doubtless there is no area within the scope of Chinese arts and crafts in which the artist or craftsman did not employ the plum blossom as an expression of beauty and symbolism. That is notably true in embroideries and no less true in the lapidary's work. Few motifs approach the refined beauty and simplicity of a plum blossom carved in white jade.

The Chinese painter and other workers in decorative arts did not outdistance the Chinese poet who made frequent references to plum blossoms. An example may be taken from the writings of the poet Chu Tun Ju (A.D. 1080-1175), and we thank Helen Wiley Dutton for her translation. "Alone in its beauty" is "a single plum tree in an ancient mountain gulch." The poet personifies the plum tree who says:

"I have escaped being locked in a garden of trees.
Far in the depths of the mountain,
No cold do I fear.
As if with the spring I could flee from winter.



The charm of a single white jade plum blossom is shown in this detail from an 18th century vase. Courtesy, Walker Art Center.

Who would understand such deep contemplation?
To rely on the companionship of another is a difficult thing.

Gay and beautiful by oneself.
Fragrant by oneself.
While the bright moon comes to seek me."

Again and again Chinese poets spoke of falling plum blossoms that "fly about like snow," or they wrote of being "intoxicated with their beauty."

In spite of all the recent changes in China, it is to be hoped that there remain those who will preserve and hand down the tradition which in days past called for water fairy flowers, the good-luck red berries of heavenly bamboo, the Buddha's hand, and plum blosso.ns to welcome the New Year.

★

White Hyacinths

By WILLIAM ARNETTE WOFFORD

I shall remember all my life
Grandmother's face that softly glowed.
While speaking of her hyacinths,
Whose fragrance filled the country road.

I close my eyes and see her now,
Bending above each scented row:
A dear old lady, gray and bent,
Whose glistening hair was white as snow.

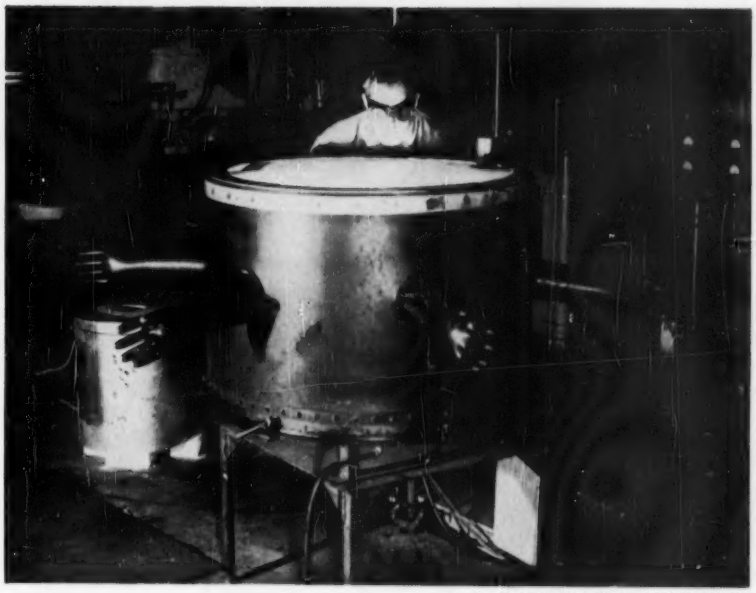
Each year in March she always filled
Her basket when she went to call;
And with her neighbors, sick or well,
She shared her hyacinths with all.

Once, in the dusk, she said to me:
"I'm glad they bloom when redbirds sing,
For you may rest assured, my child,
That winter's gone and it is spring."

Now when I see white hyacinths.
I hear her speaking in the gloom,
Although I know that she has gone
Where hyacinths will always bloom.

Titanium, Fair-Haired Metal

By E. JOHN LONG



U. S. BUREAU OF MINES PHOTOGRAPH

This weird contraption is used in titanium welding. In order to get pure, ductile welds, a sealed chamber under a protective blanket of helium is required. Rubber gloves permit the welder to work inside the chamber without breaking the air-tight seal.

IF YOU have not heard about titanium, you will. This "wonder metal," which was hardly more than a name in the chemistry books until 1948, now has airplane makers, chemists, marine engineers, rocket designers, guided missile experts, and even physicians and surgeons champing at the bit. Demand for it already far exceeds the limited supply, and scientists are being pressed to find cheaper and speedier ways of extracting it from its ores.

So highly does the government regard this "fair-haired" metal that Congress has authorized the General Services Administration to do everything it can to encourage the manufacture of titanium, even to the extent of picking up the check on any equipment rendered obsolete by virtue of the possible development of a better method of manufacture.

On the floor of the U.S. Senate, Senator George W. Malone of Nevada, chairman of a special sub-committee on minerals and fuels, declared that titanium now "is absolutely necessary and a *must* in airplane construction if we are to have the best aircraft." Defense Mobilizer Arthur D. Fleming went so far as to say that titanium is unsurpassed by any other material in importance to national security.

"What is all the shouting about? What has titanium got that other metals have not'" the average person is likely to inquire. Well, the answer to the first question is that titanium, the metal, is in very short supply, and the chances of overcoming the shortage with present methods of extraction are slim. To the second question, perhaps the best reply is *Plenty*!

As a metallic element, titanium actually is no youngster. Its existence was known as early as 1789. Its discoverer, strangely enough, was not a geologist but a minister. The Rev. William Gregor, an amateur mineralogist, investigating the black beach sand of Menachan, in Cornwall, England, found a new element. He named it *menachite*.

About five years later a German chemist named Klaproth, studying the mineral rutile, found what he supposed was a new element. Klaproth named his element *titanium*, after the Titans of Greek mythology. The Titans represented natural strength, and titanium is always found in Nature in strong combination with other elements. Klaproth did not know until some time later that his discovery was the same as Gregor's, but the name titanium stuck. Neither of them ever saw the pure metal; it was not isolated until nearly a century later, and even then its purity was only 95 percent.

Titanium, as a matter of fact, is a real clinging vine, and one of the most gregarious of metals. It readily absorbs oxygen and nitrogen, and goes into all kinds of alliances with other elements, chiefly carbon and iron. Because it is extremely difficult to extract from its ores, titanium as a metal remained a laboratory product for a century and one-half.

Until a few years ago, titanium was considered too brittle to be used as a structural metal. Then it was discovered that, if other substances could be kept from contaminating it during extractive and melting operations, a ductile metal could be obtained. This means that it can be warm-rolled into sheets and even can be worked to a certain degree at room temperature. Also it was learned that small amounts of carbon and iron acted as alloys, if properly introduced, and increased the metal's strength.

The big problem remaining was production in quantity. In 1910, Mathew Hunter of Rensselaer Polytechnic made titanitum of nearly 100 percent purity in an airtight pressure flask. Two Netherland metallurgists, Van Arkel and De Boer, in 1925, produced a metal of high purity by an iodide process. In 1940,

PHOTOGRAPH FROM DU PONT

A chunk of titanium metal sponge weighing 2500 pounds. The world's first commercial production of this metal was announced by du Pont in 1948, with a maximum output of 100 pounds a day. Continuing process research and plant expansion increased output to ten tons a day by 1954.

William Kroll, a native of Luxembourg, patented the process now in general use. Industry did not immediately recognize its possibilities, but when Dr. Kroll fled Europe just before the Nazi invasion of Luxembourg, and joined the U.S. Bureau of Mines staff in 1944, things moved rapidly. With Frank S. Wartman of the Bureau of Mines, Dr. Kroll soon perfected a practical way of making commercial grades of the metal.

So much for the process. The Bureau of Mines and Dr. Kroll, however, still were faced with the question as to whether any commercial company would take over production. Before any firm would risk the capital necessary for buying equipment and training people to make the new metal, it had to be certain of a market for the product.

Finally the Bureau of Mines had to go ahead itself, enlarging its laboratory to pilot-plant scale. At Boulder City, Nevada, it built a plant capable of turning out 100 pounds a week, and by late 1944 a physical metallurgy section was testing titanium's engineering properties, first at Salt Lake City, and later at College Park, Maryland.

Then came the super-sonic air age! The demand for greater and greater speed put severe strains on existing metals and their alloys. The need for long-range aircraft called for materials with higher strength-to-weight ratios. Extremes of temperature in super-sonic travel cried aloud for some better heat-and-cold resistant material. Rockets and guided missiles had their aluminum "skins" burned off by the heat generated through air friction alone; sub-zero colds of the stratosphere rendered many metals brittle.

Laboratory tests of titanium and some of its alloys, now extended to Army and Navy as well as Bureau of Mines' experiment stations, indicated that here might be the answer to a lot of prayers. Only 56 percent as heavy as steel, titanium is as strong as ordinary varities of steel. Although 60 percent heavier than aluminum, it is six times as strong as the unalloyed metal, and while aluminum alloys lose their strength between 700° and 800° Fahrenheit, titanium stays strong up to 1000° F. The Office of Naval Research found that titanium has "useful engineering toughness" in temperatures ranging from 100° to 600° F., and higher—a truly remarkable spread.

As extra qualities, titanium will not rust like iron, and resists the attack of many corrosive acids. Even sea water or salt spray fail to affect it.

Titanium's original proponents, in fact, became so excited about its many possibilities as a structural metal that some of them glibly promised it would do *anything* any other metal could do, and do it better. Continued research in the past decade has sobered these early, over-enthusiastic claims for the metal, but there can be no denying that titanium has already established a commanding place among metals, and promises to become as useful an engineering material as stainless steel, which it may replace in many ways. Scientists admit that the industrial usefulness of titanium has as yet been only partially explored.

Commercial production of titanium, under the Kroll process, dates from 1948, when the E. I. du Pont de Nemours and Company, operating under a government contract, announced the first extraction of the sponge metal from its ores, at Newport, Delaware. Soon another company, Titanium Metals Corporation of America, was in business at Henderson, Nevada, along with the U.S. Bureau of Mines pilot plant at Boulder, Nevada.

But all three of these producers turned out only 2241 short tons in 1953, which is some 23,000 tons below the present annual needs of the military alone. However, the 1953 production represents quite a jump upward from three tons, in 1948, and 500 tons, in 1951. As rare metals go, and considering the costly difficulties that are still involved in the Kroll process, this is meteoric progress—probably the fastest in the history of metals.

Advocates of titanium are not in the least discouraged, either by the comparatively small quantity of sponge and finished metals now being produced, or by the current high market prices. Pure, commercial titanium metal is quoted from $15 to $30 a pound, and sponge titanium at $5 a pound. But, it is pointed out, stainless steel and aluminum were once quite expensive.

Fifty years ago aluminum cost from $40 to $50 a pound; today it sells from 18 to 20 cents a pound. Barring a technological miracle, titanium will probably not be produced that cheaply, but Senator Malone's committee is confident that, in "the near future," titanium will be selling from $2 to $3 a pound, and be in fairly plentiful supply.

Fortunately titanium *ores* are abundant. In actual quantity, titanium is the fourth most abundant structural metal in the earth's crust, being exceeded only by aluminum, iron and magnesium. As the ninth most plentiful *element*, it surpasses in quantity such better-known cousins as copper, lead, zinc and tin, which together make up less than 0.111 percent of the earth's crust. Titanium alone comprises .62 percent.

Actually titanium ores are found everywhere, although deposits large and rich enough to be worth mining are widely scattered. Both of the principal titanium-bearing minerals, *rutile* and *ilmenite*, are found in the United States. Rutile deposits occur in Virginia, Florida and Arkansas; ilmenite is found in New York, Florida, the Carolinas, and Idaho, as well as in several Canadian provinces. Other titanium-bearing ore bodies have been reported from California, Colorado, Maryland, Minnesota, Montana, Rhode Island, and Wyoming.

PHOTOGRAPH FROM DU PONT

Mining sands in a north-central Florida lake to get ilmenite, a black ore that is the raw material for titanium dioxide, the whitest white pigment ever made, and for titanium metal.

Although the metal itself is a comparative newcomer, if you are a careful reader of labels you will have seen the name "titanium" as a constituent of a number of things that have been in common usage for many years. Most linoleum, for instance, contains titanium dioxide, a white pigment. A dye containing this oxide is used to color leather, or to whiten false teeth. Many face powders contain titanium compounds, as does house paint. Powdered titanium tetrachloride is used in airplane skywriting. The paper upon which this is printed probably contains some titanium pigments, to make it white and less transparent.

All of which seems strange when it is considered that titanium oxide, the whitest material known, comes from dark sands, or ores. Rutile ranges in color from red to brown, although it is sometimes blue, black or even green. Ilmenite comes in iron-black, generally, but may also vary from red to brown.

So recent is titanium's advent into the realm of metals that the Smithsonian's Hall of Minerals still lists its most important use as "pigment."

What are some of titanium's new roles, in what is called the "growing-metals group," which also includes aluminum and magnesium?

Much of the information on military applications for titanium is restricted, but it is obvious that a strong, light metal can be used advantageously in aircraft, ship and ordnance design. Foremost usages are in jet engines—compressor wheels, rotor blades and spacers, firewalls and fittings around exhaust systems. Here the fact that titanium's tensile strength equals that of stainless steel in temperatures up to 800° F. makes it a likely replacement for the heavier metal in jet-engine parts exposed to middle temperatures (300° to 800° F.). Its comparative lightness makes it desirable also for landing gear, engine nacelle covering, fasteners and bolts, and even airplane armor.

As super-sonic craft and missiles develop, titanium alloys will probably be used exclusively for leading edges of wings, fins, and other parts that get too hot from air friction for ordinary aluminum alloys.

Aircraft designers estimate that a bomber using 25 to 40 percent titanium can travel at supersonic speeds of 800 miles an hour, or greater, for 7000 miles without refueling. This is far beyond present non-stop ranges. Obviously the commercial airplane industry is licking its chops, impatient for the day when enough titanium will be left over from military needs to be used in civilian plane construction. Every *pound* of weight saved in construction of commercial planes makes possible a reduction of engine size and fuel requirements that shows up in the books as an increase of *$200 in annual revenue*!

Ground forces also have their bids in for a share of the military quota. A mortar-plate made of titanium can be carried by one man, reducing the mortar crew from 4 to 3 men, and increasing fire power by 33 percent per man. Tanks and other armored vehicles can be lightened, increasing speed and reducing fuel consumption.

Although we shall probably never have battleships made of titanium, the Navy would settle for small quantities of this corrosion- (Continued on page 50)

Confessions of a Vivisector

By MARTIN FISCHER

Animal experimentation, often inclusively but not too accurately called "vivisection," is a controversial subject. Even within the ranks of the humane movement there are varying shades of opinion. Certainly frivolous, unregulated and inhumane practices are inconsistent with the progress of civilization. On the other hand, discoveries made through experiment and research with animals have been of immense benefit to mankind. One view of the issue is interestingly and provocatively presented herewith by Dr. Fischer, who is emeritus professor of physiology at the University of Cincinnati.

MY Bavarian-born housekeeper, married to a GI of the world's latest breakdown, is possessed of uncanny ability to make things sprout and live. She exhibits her capacity not only in a garden outside, but by one inside the house, the latter composed of varied kinds of diminutive containers carrying diminutive plants. She watches over several dozen such units, and they fill every vacant shelf and every bare spot on the walls of her domain. Along with this interest in the vegetable world, goes one in the animal. I make no count of twenty-six pigeons, two pairs of bluejays and six redbirds that hang about her kitchen door, but the presence of six squirrels within the house must be recorded. At the moment the within-doors' biological setup consists of two Siamese cats, three canaries, two pairs of Australian parakeets and a newly installed aquarium containing tropical fish. When spring was still elusive, the aquarium shared the back of the stove with a home-made incubator in which rested the egg of a robin, perhaps cast out by an unwanting mother, and found in the grass.

While Alma talks constantly to her charges, she rarely addresses me; but last week she did. In the storm raging at the time, I was making my way into the house via its rear steps when she stopped me cold. "Doctor," she inquired, "do fish suffer pain?" That was a poser, even for a professor. But since professors are expected to know everything, I did the best I could to uphold the reputation of the craft.

To this end I recalled the observations made, more than fifty years ago, in the Marine Biological Laboratory at Woods Hole, Massachusetts, by a Texas biology teacher named, W. W. Norman, who was associated at the time with Jacques Loeb. Norman did not exactly answer my Alma's query, but what he had observed bore heavily on the subject.

Norman had asked: "Do the reactions of lower animals indicate pain sensations?" To get an answer, he had chopped a lot of earthworms in two, discovering that after this injury the head end (supposedly the recipient region of sensation) always continued to move forward quietly, even as the tail end contorted. He now cut each half-worm in half, to find that the anterior quarters continued to be or became quiet, even as the posteriors began to, or continued to wriggle. Linking the four pieces together by loops of thread, he found that the whole animal moved forward again as though nothing had happened.

Such was the story, too, of other worms of a social order both below and above that of the rainworm. But what did all this have to do with fishes?

Everybody is familiar with a fish's gyrations when pulled out of water. Do not these fits represent a reaction to pain? In this belief the vivisectors of fish have anesthetized and by mechanical means have tried to hold them quiet for operation. Neither scheme works; and both are examples of how to do things the hard way, for all that is needed to keep even a shark quiet while subject to gross surgery is to see to it that a well-aerated stream of water plays through its gills. Thus supplied with oxygen, the animal struggles not at all and requires no holding devices whatsoever.

I have rarely discussed these findings with my associates; and never with my younger students. This was to keep them free of a false conclusion, for Norman's experiments do not prove that the animals suffer no pain but only that their uncoordinated movements are not proof of such. And it is most important for the student that he hold to the assumption that suffer they do, for only so will he learn, early, proper regard for the laboratory animals about to lay down their lives for him.

We know that pain follows injury only as the human subject is concerned, for only he is endowed with the power to tell of his sensations to another. Thomas Lewis in *Pain* has recently put it well: "There are no reliable and usable indices of pain in animals; there are only phenomena recognized as frequent associations of pain [cries, deepened breathing, dilated pupils, raised blood pressure and the assumption of attitudes of defense or offense] . . . our knowledge of pain has been built up, and will continue to be built up by observations upon man." What Norman proved, therefore, was not that animals, upon operation, suffer no pain, but only that what the operator sees is not evidence for such.

Although the general belief goes otherwise, it is only a small portion of the public that has ever shown itself at all sensitive to what may be pain in animals. The half of the Europeans are to this day sure that because the animals they beat are without souls, they are therefore also without the capacity to suffer. It

is a minority that has believed the opposite. In our country they compose the humane societies and stand organized under various urban, state and national names. Their interest is chiefly in the domestic animals and only sporadically in wild creatures, but what they have done for the domestic animal's protection is much. By the turn of this century they had removed the checkrein, withdrawn the whip and watered the exhausted horse; since when they have bettered the housing conditions of our farm stocks in barn and boxcar, and have largely eliminated the spur and the goad.

If a date is desired as to when all this started, call it 1875. At about that time Britain enacted an animal practices law that forbade cockfights, bull-baiting and similar "sports"; even as she so early passed regulations as to when and how animals might be employed as vivisectional material in a research laboratory.

PHOTOGRAPH BY LUCILLE ALLBRITAIN

This shrine in Tokyo is a memorial to the researches in the field of anti-toxins by Dr. Shibasaburo Kitasato.

No one of heart or intelligence has ever filed objection to the attempt of the humane societies to rescue, protect and by painless method bring death to the hopeless. What was objected to in this try at the suppression of cruelty to animals was their invasion of the medical laboratory, where, dubbed antivivisectionists, they have for some seventy-five years past been alternately wrong or right. To convert the onlooker to the antivivisection cause, it was common practice, in the first of these decades, to exhibit the paraphernalia employed by the vivisectors in their operative endeavors. Viewed superficially the stuff looked bad; but the horror evoked, quickly subsided when interested persons were given entrance into any well-equipped surgical pavilion. It takes an equally fearful lot of castings, steel pipes, and straps, which only a Houdini could unloose, just to hold a human subject on the table; not to speak of the additional restraints required to keep him in proper position for surgery on his head, his loins or his backbone.

Within the last several years the argument has become largely one between the professionals themselves, instead of between the laity and the professionals. For many years past the American societies for physiology, pharmacology, biochemistry, pathology and nutrition—with membership running to several thousand—have stood united in a *Federation*. It sponsors the publication of a *Bulletin of the National Society for Medical Research*, the purpose of which is to shelter and if possible to aid the vivisector in his labors. By word and by picture it has quieted much public hysteria, even as it has proved many times over that the life of a dog or a cat within the walls of a biological laboratory may not be altogether bad.

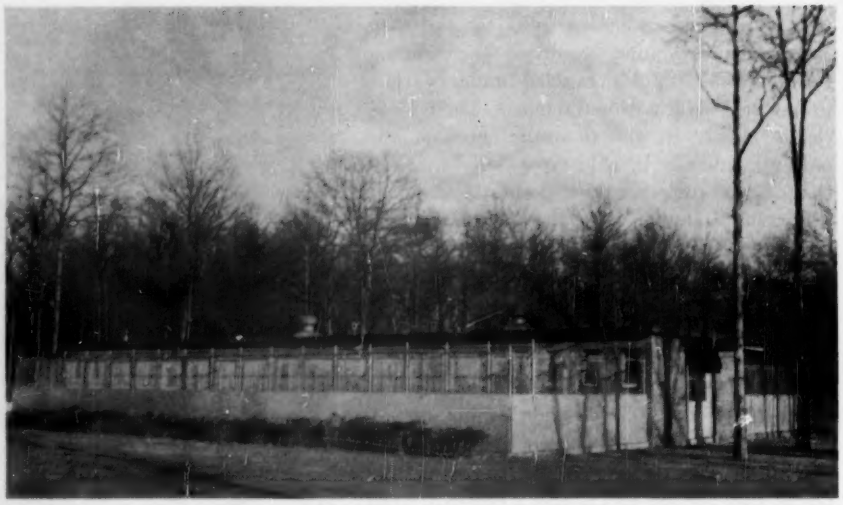
But does scientific curiosity at times overreach itself? This is what the late Dr. Robert Gesell, chief of physiology in the Medical School of the University of Michigan for thirty years, claimed when, in recent issues of the *Report of the Animal Welfare Institute*, he addressed himself to the *Federation* on "abuses in animal experimentation." His recitation of such abuses, as found all over the world, made poor reading. It was senseless, he said, to keep repeating experiments about which we already knew the answer, just to bolster the statistics of "career" scientists. Critics fell upon him at once, charging him with being an "antivivisectionist." In truth, his brilliant contributions to the physiology of breathing could never have been made without vivisection. His objection was to the *methods* pursued by some of the biological workers because not always "humane"—even when excused because "scientific."

It is impossible to be a physiologist without being a vivisector. As the anatomist cannot do without a cadaver, so the physiologist cannot do without some kind of the living stuff. But the novice in "experimental medicine" should realize early that in its procurement he is given broad choice.

The cry of the antivivisectionist is kept alive by something very simple—here and there a dog or a cat disappears into a medical school and does not return! Avoid this embarrassment by not experimenting on dogs and cats. Rabbits and guinea pigs are less known to the antivivisectionist; and he is likely to hate snakes, rats and mice. If retort is made that these subjects are anatomically too small to allow of such surgery as recently showed the doctor how to save the blue baby, then do as the Mayos did and try a pig, a sheep or even a calf.

Although active all my life—specifically since 1897—in the animal laboratories of half a dozen so-called medical centres, no agent of any humane or any antivivisectionist society ever bothered me, even though

subject to his inspection many times. Oddly enough, the only authority who did bother me was one of the eight medical deans under whom I have served in Cincinnati. He took me to task because I accepted credits in physiology brought to me from a distant laboratory, even as the chief of that laboratory would not accept mine. The dean explained that, in the Chicagoan's opinion, I "did not kill enough dogs." Ironically, my critic was talking out of the very laboratory into which, under the chieftainship of Elias Potter Lyon, I had helped to introduce a course intended to repeat what are known as the classic experiments of mammalian physiology. Observing that our picked students had greater interest in the surgery they were about to perform than in any principle of physiology they would learn, we quickly discontinued it.



PHOTOGRAPH FROM MERCK INSTITUTE FOR THERAPEUTIC RESEARCH

Exterior view of the carefully kept dog kennels at the Merck Institute in Rahway, New Jersey.

The immunity of the forty-year-old Joseph Eichberg Laboratory for Physiology in the University of Cincinnati to the antivivisectionist is easily explained. It never used a dog or a cat when some other animal would serve. When dogs and cats were used, they were never experimented upon more than once; and quiet and immediate death was assured the victims unless survival was necessary for further observation. In latter instance the animal was never allowed to suffer more pain than that incident to a surgical endeavor on man; and every survivor was to become a pensioner of the laboratory.

From the first, vivisectional operation was entrusted only to the competent. By the sacrifice of just one animal, the able individual can do for many students what the incompetent cannot accomplish for the few by the sacrifice of many. But mammalian physiology is most quickly learned when the medical student is ordered to operate upon himself. The nebulous becomes real when he aspirates blood out of his own vein, swallows a stomach tube, tries breathing into a paper sack, exhausts himself by a swift run around the block; and even one day without food or water will rouse him to better understanding of what is war or drought.

The antivivisectionist cannot object if you experiment with plants instead of animals; aquatic animals instead of the terrestrial. The total of the growth problem is contained in a seedling; what you do to hellbenders, salamanders and carp rarely excites anybody; and nobody cares how you treat aphids or a smut.

Most antivivisectionists stand arrested in their crusade as soon as it is explained to them that the purposes of vivisection are those of medical education and the discovery of the better way in medicine for the happier and longer life of all living things. When mere argument does not carry, the objector may be welcomed into the laboratory and shown the quarters for the animals. This will permit comparison with the living quarters of much of the human race, not to mention the domesticated animals. But even here the structurally best may not be the best for the animal. Tiled and vermin-proof housings atop a skyscraper still smell more of the penitentiary than of the field; all animals long for a box set upon the ground with a runway attached, wherefrom it is possible to look upon the sky.

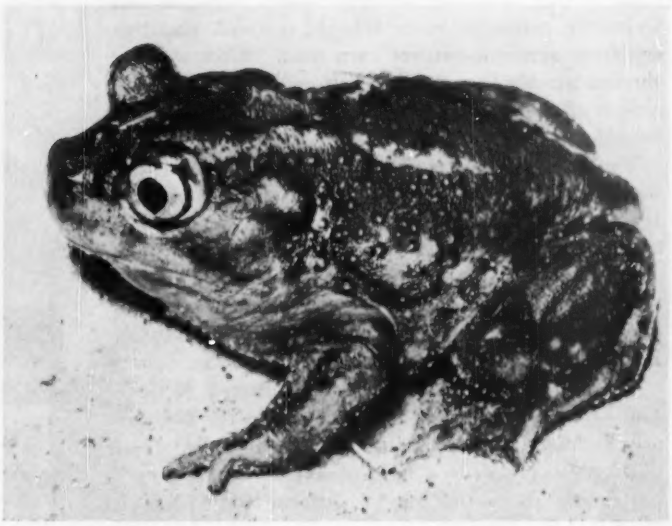
I have always belonged to the soft-shelled among the vivisectors. This stand, I believe, exhibits my intelligence. I believe, too, that only conscience can settle the differences that arise between the vivisector and the antivivisectionist. Properly informed, the antivivisectionist usually gives up; but the vivisector is too likely to keep on. Since the antivivisectionists have never won their case in any court —not even in England—the vivisectors have tried further to strengthen their position in law. To this end they have devised "seizure" laws under which government agencies are called upon to turn over to our "medical" research institutes any demanded number of impounded dogs and cats. It is the stupid way of getting what you need, for the greatest of animal lovers will bestow his pet upon you when you explain to him that the animal will die for a great cause. This attitude delivered to the Army all the dogs it wished, to train them to carry bombs into the enemy's trenches. It blew up the enemy—but also the dog.

Even when the antivivisectionist secures his case, his victory is small, for suffering carries not only the factor of intensity but of extensity. The number of animals sacrificed for medical (Continued on page 51)

Hermit of Frogdom

By C. J. STINE

Photographs by the Author



A spadefoot appearing somewhat startled after having been rudely awakened from a long nap in an underground hideaway.

FROGS are usually sociable creatures. They spend their time, during the warm months, with members of their clan, swimming about in water, or perched on the edges of streams and ponds, catching insects with their long, sticky, protrusible tongues.

The hermit, or spadefoot, is a notable exception among gregarious amphibians. Rated low on the ladder of amphibian evolution by taxonomists, the spadefoot is unique because of its bashful habits.

Only about eight kinds of hermit frogs are recognized by biologists. As a group they are found from New England and British Columbia southward through Mexico to Cape San Lucas and the plateau in Oaxaca.

Although the hermit ranges over a large area in the Americas it is not often seen because of its love for burrowing. This frog is two to three inches long, but broad of body. Usually brown in color, it has two irregular, pale-colored stripes on the back. The skin has scattered warts.

In addition to the usual amphibian qualification of a thin, glandular skin, Nature has given the hermit several supplementary features that enable it to face life with stoic calm. Most important of these assets is a large, dark, horny process on the inside of each hind foot. It is known as the spade, and with it the hermit digs his cave, usually choosing soft ground in which to burrow.

Watching a spadefoot dig in is humorous and enlightening. Starting from a sitting position, the animal begins a deliberate, slow, rocking motion of its hind end. This lateral action pushes the soil aside so that the animal sinks backward beneath the ground, the earth falling in over it and leaving no trace on the surface to indicate its course. The burrow may vary in depth from a few inches to several feet. A gravedigger once found one more than three feet in the ground, without a sign of an entrance or exit! Six of of my captive specimens required only several minutes to descend from the top to the bottom of a ten-gallon aquarium filled with loose soil.

In some localities the turnip-shaped burrow is kept open, and sticky matter is arranged around the entrance to aid in snaring insects. With such a cavern, the solitary spadefoot is content to stay close to home.

In other areas the hermit is filled with a sort of wanderlust, and may be found at night away from home, lurking beneath lighted signs and waiting for a winged meal.

The spadefoot is most sociable in the blush of the spring. Then they leave their burrows en masse, for a short time, to congregate in a body of water for propagation of their kind.

The spadefoot breeds from March to September at periods of heavy rainfall, and in ponds and puddles of a most transitory nature. A friend of mine once found a small congress breeding in a mud puddle in front of a busy shopping center.

The voice of the spadefoot is another of its remarkable features. On the first evening of April, several years ago, after an all-day

The webbed foot of the spadefoot showing the black, horny inner tubercle that serves this amphibian as a digging spur.

rain, I was collecting swamp chorus frogs on the Delmarva peninsula when I heard a weird, plaintive cry from across a cutover corn field. After walking through muddy furrows for a half-mile, I found a large chorus of about two hundred of the eastern spadefoot, *Scaphiopus holbrooki holbrooki*.

The call of the lonesome male attempting to attract the female is one of Nature's most unusual sounds. It has been described by various naturalists as sounding like young herons in a herony, like the squawk of an animal in pain, like the bleat of a lamb, or the creaking of an old wagon wheel. To me it sounded like the cry of a cross baby, but with infinitely more volume. It was a nasal *waah, waah, waah*.

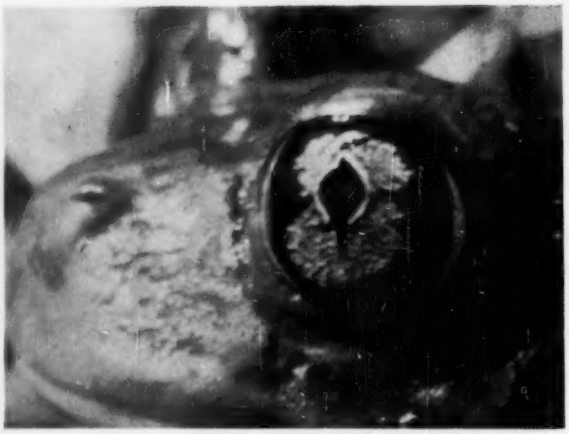
The throats of the calling males, inflated to three times the size of their heads, glistened in the beam of my flashlight like gleaming white golf balls. The passive females floated half-submerged, bulging eyes protruding above the water's surface, looking for all the world like miniature hippos. The light, when cast upon the eyes of the amphibians, caused the pupils to contract until they were mere vertical slits, indication that here were creatures of the night.

The noise of the chorus itself was so great it disturbed cows, chickens and dogs on a farm nearby, so that these animals set up a din.

One naturalist recorded hearing the muffled voices of the hermits calling from their underground hideaways. Excavation through several inches of sticky clay revealed the songsters in quite solidly packed earth!

A most peculiar aspect regarding the hermit is that it may breed for one or two nights in a chosen spot; then never be seen there again.

Nature also protects the spadefoot by endowing



The eye of a spadefoot just turned out of its burrow. This amphibian, like many nocturnal animals, has eyes with cat-like, vertical pupils. The light-gathering of an elliptical pupil is less than that of a circular one, and thus protects a supersensitive retina.

the eggs and tadpoles with a rapid rate of development. The eggs hatch in several days and the larva transform in as short a time as two weeks. The mortality rate is highest, for amphibians, in the egg and larval stages.

There are hazards, however, against which Nature has provided no defense. Once I returned to a breeding site during the day to find several ducks on the water so heavily gorged with tadpoles they could not leave the pond.

There is no reason to pity the hermit of frogdom because he lives in solitary confinement in the earth's crust for most of the year. His extensive range and long presence on earth prove him to be a successful species, to be admired as one of evolution's showpieces.

★

Noddy's Hot Nest

By HUGO H. SCHRODER

Photograph by the Author

WHEN I visited the Dry Tortugas I found numerous pairs of noddy terns along with the many thousands of sooty terns that nested there. Some of these noddies had unusual nesting sites, one in particular choosing to place its single egg in just about the hottest place it could find. This was on some fallen ironwork at the old coaling station. To make it still hotter, there was a sort of nest of rusty iron chips. Other noddy terns used similar rusty iron chips for nest lining, along with broken bits of shells, while some used only the shells. Here the female sits beside her egg under an overhang that at least provides some shade during a part of the day.

Aquarium Fishes

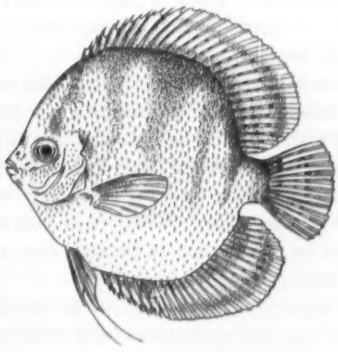
By E. LAURENCE PALMER

Illustrated by Ellen Edmonson and Hope Sawyer

This is the seventy-ninth in NATURE MAGAZINE'S *series of educational inserts.*

MY FIRST aquarium was a quart fruit jar. In it I watched tadpoles emerge from the long strings of toads' eggs I had put into it. Then, after reading Dan Beard's *American Boy's Handybook*, I raided the attic and, from glass taken from the portraits of my ancestors, made an aquarium of sorts that really worked for awhile. Now the desk beside my typewriter, and another desk on the ground floor of my home, support aquaria finer than any I dared dream of as a youngster. Their greatest shortcomings are that they are so interesting that I am inclined to put in too much time watching them instead of doing the work that may be at hand.

ANGELFISH



POMPADOR FISH

This insert is prepared for those who may be interested in an introduction to aquarium management. At the end, we have given a bibliography that may be consulted by any who may wish to pursue in more detail the suggestions made here. One thing about aquaria is certain, you can take them or leave them. If you stock your little water world with fishes from nearby ponds or brooks you may abandon the idea simply by returning the fishes to the place where you got them. If, on the other hand, you stock your bit of indoor pond with expensive tropical fishes you may not feel like sacrificing your rather considerable investment. The best thing under these circumstances is to test the extent of your interest with something inexpensive. Then you can either grow into the aquarium fan you suspect you may be or you can withdraw gracefully whenever you wish.

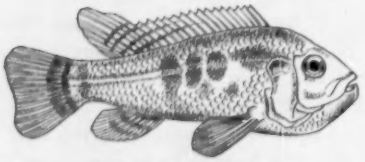
Whether you use a simple fruit jar for your aquarium, a standard framed aquarium, or get one with a heater, a filter and an aerator, there are a few things all will have in common. The water must be suitable for the fishes you accept as guests. If the fishes naturally live in warm, sunny areas the water must have sun and must be kept from getting too cold. If the fishes require much oxygen you must supply it to them. Your finny pets must have a certain amount of privacy and must be protected from their enemies, whether these are other fishes, or fungous or other diseases. In all probability you will want some plants and these will have needs that must be met. In other words, to maintain an aquarium satisfactorily you will find that you have to be to some extent a biologist. This may mean that you will want your aquarium to support just the right amount of plant and animal life to relieve you of responsibility. If you are willing to buy the equipment and keep it in operation, and risk the possible loss, you can treat the water in the aquarium so that it supports an abnormally large population.

A few rules of thumb have been developed for those who wish to keep an aquarium that will more or less take care of itself. According to the rules, to keep goldfish you should see to it that for every inch of goldfish—not counting the tail—your aquarium has twenty square inches of water surface and two gallons of water. In other words, you should add the lengths of the fishes you intend to keep, multiply the number by twenty, and then see to it that you have that many square inches of surface exposed to the air. To get the number of gallons to be found in a straight-sided aquarium multiply the length of the aquarium by its width and the result by the depth of the water, then divide the resulting number by 231. Length and other measurements here given are in inches, of course. It is possible to maintain fishes of the proper length in an aquarium without much care. Goldfishes are probably the easiest kinds to use.

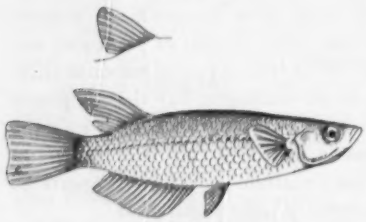
The water in your aquarium must be suitable for the fishes being kept. Suitability involves cleanliness, temperature, chemical nature, amount of light and oxygen present, and a few other requirements.

For goldfishes the temperature of your aquarium water may be between 55° and 70°F., normally. Temperature requirements for some of the more popular aquarium fishes are given in the tables in this insert. They should be followed if you wish success. Exposure to strong sun-

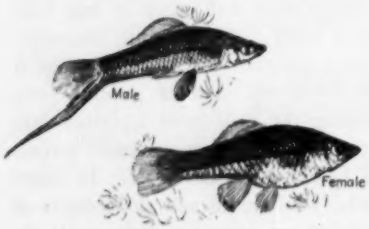
SAILFIN KILLIFISH



MOUTHBREEDER

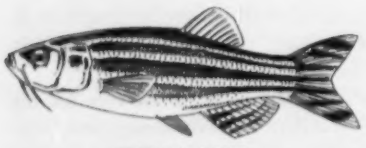


MEDEKA
(Female dorsal fin above)



SWORDTAIL

PARADISE FISH



ZEBRA FISH

BROOK STICKLEBACK

light may well raise the temperature of an aquarium to such a point that the fishes in it cannot survive. It is well, then, so to place your aquarium that it may not be dangerously warmed at any time of the day. Similarly, undue cooling often must be avoided, and this means that for tropical species the aquarium should be in a room where a constant temperature of around 70°F. is maintained.

If you have expensive fishes, and cannot be guaranteed that the aquarium water will not be chilled, a heater purchased at an aquarium supply store may be a good investment. These are usually so made that they turn themselves on automatically when the temperature drops below the danger point.

Light is important for many reasons. A fair amount of light is necessary to maintain the plants in your aquarium. These plants will supply food and shelter for some of your fishes and will add oxygen to the water in the presence of sunlight. Too much light may over-encourage plant growth. As a result it is a common practice, in schools where aquaria are kept on windowsills, to cover the sides of the aquarium exposed to the sun with something that will cut off the light. A mirror with the reflecting surface toward the interior of the aquarium not only serves to cut down the light but it apparently doubles the number of plants and animals in your aquarium without increasing the demands for space and oxygen.

The chemistry of the water in your aquarium may be most important. The tables in this insert comment on some of the needs of fishes along this line. Some require salt; some a slight amount of acid, and others may do better in water that is slightly alkaline. The tables provide some guidance as to how these needs may be met in special cases. Frequently goldfishes may be attacked by fungi that form fuzzy white patches on your fishes. Sometimes these patches may be removed by giving your finny friends a salt bath for a short time; or a series of short baths may be even better. Directions for doing this are to be found in the tables.

Many times a long-neglected aquarium may lose too much of its water by evaporation. Usually this situation may be avoided by covering the aquarium with a sheet of glass, leaving some air, of course, between the cover and the water surface.

Accumulations of silt often make aquaria unsightly and unhealthy. If your aquarium has a filter this situation may be avoided. These filter pumps return the water to the aquarium after the wastes have been separated by passing through glass wool and charcoal. Filters are inexpensive to purchase and operate, and are useful if you really want to have an attractive aquarium with many fishes in it. However, if you are attempting to rear fishes some barrier must be maintained to prevent eggs and young being removed in the filtering process.

Frequently filter pumps are so designed that when the water is returned clean to the aquarium it carries with it some air, and this definitely helps in the problem of aeration. Aquarium fans usually prefer that when this air is added to the water it be done in such a manner that an attractive stream of bubbles comes from somewhere in the aquarium. If this appears to come from inside a shell, or from a model of a sunken ship, or even from under a stone, interest is aroused. The essential thing, of course, is that air taken from the water by the breathing fishes is returned to it in some way or another. If you depend upon plants to do this you cannot maintain many fishes. If you depend on a pump, then the number of fishes may be increased, usually to your improved satisfaction.

While a filter will keep the water in an aquarium really clean, there are other means that are sometimes used. Water snails move about the glass of an aquarium, feeding on algae growing there. Some fishes are definitely scavengers, as the tables will show, and these may help keep an aquarium clean. However, where you depend on fishes and snails there will come a time when their wastes will accumulate on the aquarium bottom. When this happens, it is best to remove the wastes. It is not necessary to change the water completely to do this. A rubber tube, used as a siphon, may permit you to remove the major

accumulation of wastes without disturbing the plants and animals in the aquarium to any great extent.

In planning the population of your aquarium you must consider the temperaments of the fishes you hope to maintain. Some fishes are too pugnacious to live in harmony with others. Some will eat their own eggs and young, or, in times of courtship, will ruin their prospective mates. All these things must be considered if you are to succeed. It may be best to maintain more than one aquarium. Then troublesome fishes may be kept away from their mates, except when they are needed. A simple trick of separating an aquarium into two parts by a sheet of glass will often serve your purpose. This also provides interesting spectacles when fishes try to break through the glass to reach the objects of their attention on the other side.

The food problem is always an important one in aquarium management. Where possible it may be best to select fishes that feed on plants that you can raise easily in the aquarium. Usually aquarists like to add artificial food that the supply houses are most anxious to sell. The danger in feeding usually lies in giving the fishes more food than they can eat, and then trouble results from food spoilage that may contaminate the water. Many elect to maintain small aquaria in which cultures of water fleas may be reared. When needed these may be dipped out at will and put before your fishes.

If you plan to hatch eggs and rear young fishes it may sometimes be necessary to protect the young from their parents. If a wire mesh is spread in the aquarium so that the eggs and young may drop through, while the parent fishes are kept out, this may be of help. But where parental trouble exists it is usually best to remove the young to separate rearing aquaria. Any good aquarium book listed in our bibliography will provide the necessary details.

The fifty-sixth of these special inserts dealt with pond surface plants, many of which are suitable for use in aquaria. We refer you to this rather than attempt to repeat the information there provided. Shortly, we hope to give you another insert dealing with pond and stream plants that do not normally come to the surface. In the meantime you may get the help you need by consulting the references in the bibliography. Some of these plants may be found in great abundance in a nearby stream or pond, and may be superior to those you may have otherwise to buy in a supply store. This is not suggested to discourage you from supporting supply stores, but merely to suggest that you will find it useful to correlate your aquarium with the water life of your neighborhood.

Some may get so interested in management of water animals in little aquaria that they may decide to develop a hobby into a business. There are considerable commercial possibilities in this activity. You may wish to raise a few high-priced fishes and carry on in that way. On the other hand, you may be near a city market and decide that you wish to raise great numbers of goldfishes to supply the local demand in the five and ten cent stores. You may also feel that you want to raise fishes to be sold to fishermen for bait. You might also wish to contract with wealthy local residents who have ponds in their own backyards that need to be stocked each year with new and interesting fishes. Whatever you may elect to do, it is certain you will find plenty of opportunity to use all the ingenuity you have to raise, to watch, to sell, or to learn from the fishes in your aquarium, no matter how large it may be. Possibly there may be a neighbor who has physical infirmities that make it necessary that he seriously rest during much of his life. To such a person the gift of a stocked aquarium may be an act of great kindness. Think this over.

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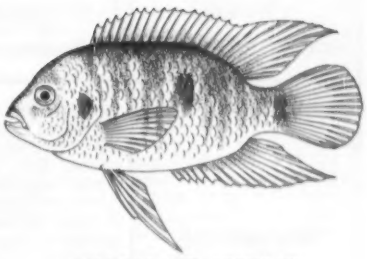
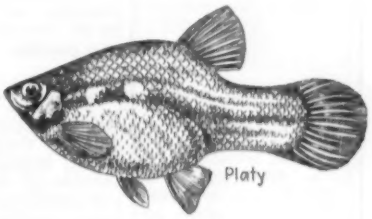
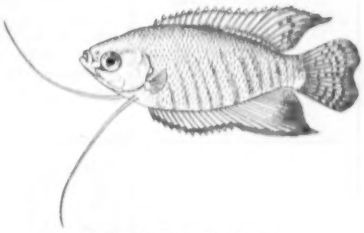
(Continued on page 32)



CHOCOLATE CICHLID

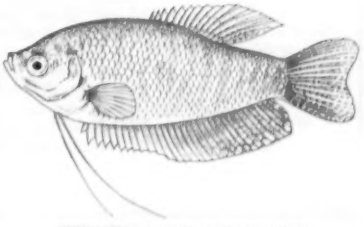


PLATY



STRIPED GOURAMI

FIGHTING FISH



THREE-SPOT GOURAMI

GOLDFISH

NAME SCIENTIFIC NAME	GOLDFISH *Carassius auratus*	ZEBRA FISH, ZEBRA BRACHYDANIO *Brachydanio rerio*	HORNED DACE, CREEK CHUB *Semotilus atromaculatus*	BROOK STICKLEBACK *Eucalia inconstans*
DESCRIPTION	Length to more than 18 inches, but usually much smaller. Usually red and white, but sometimes black, mottled, brown, or olive. Scales relatively large and surprisingly uniform. Head relatively small and mouth terminal. Fins highly variable because of breeding and selection by fish breeders. Weighs to 4 pounds.	Length to 2 inches. Conspicuous fish with longitudinal stripes running as straight as though a ruler had been used on body, fins and tail. Stripes are alternating blue and silver, changing to black and gold. There are a number of closely related species with color variations.	Length to 10 inches. Large mouth. Scales smaller and crowded in front of dorsal. A conspicuous dark spot at front and base of dorsal fin. More or less olive above and brownish, becoming pale to white, beneath. In breeding season males may become red or purple in areas, and develop rough areas on head.	Length to 2½ inches. With 5 dorsal spines not conspicuously connected by a membrane. Body naked. Area supporting tail slender. Can change color but is usually olive green, being darker above and lighter beneath. Back and upper areas frequently mottled. Males usually smaller and darker than females.
RANGE AND RELATIONSHIP	Order Cypriniformes. Family Cyprinidae. Closely related to carp. Introduced from Asia and established in some waters intentionally or by accident. Has less than 30 scales in lateral line, while the carp has more. Lacks fleshy structures found at side of the carp's mouth. In Nature reverts to brown color.	Order Cypriniformes. Family Cyprinidae. Native of India and Ceylon, but widely established over the world as an aquarium fish. Pearl danio, *B. albolineatus*, is slightly larger than the zebra and less conspicuously striped. The giant danio is even larger, with conspicuous blue and yellow stripes and red on fins.	Order Cypriniformes. Family Cyprinidae. Ranges from Maine through southern Canada to Wyoming, and south to Georgia and New Mexico. At best in clear, cool, swift streams favored by brook trout and black-nose dace. In breeding season most common near riffles where nests are built.	Order Gasterosteiformes. Family Gasterosteidae. Found from British Columbia to Kansas and east to Maritime Provinces of Canada and western Pennsylvania. Most abundant in weed-choked bogs, springs and small streams. Related species in fresh waters and seas of America, Europe and Japan.
REPRODUCTION	Mates during day, usually in April and May. Female lays to more than 500 eggs in lots of 10 to 20. Eggs amber, sticky, cling to supports and will hatch in 3-7 days at 70°F. Adults do not protect eggs or young, or make any nest. Breeds in shallow water. Breeder has body more than 2 inches long.	Breeds at 80°F. with eggs being laid while pair may be swimming at breakneck speed. Eggs measure .6 mm. in diameter; may be laid to 95 per spawn at intervals of 12 to 14 days and requiring to 30 minutes for a complete spawn. Eggs hatch in 56 hours at 75°F., or may delay 10 days. Young mature in 3-7 months.	In early summer or late spring males move pebbles on bottom of a riffle, making upstream ridge and pit below. One or more females may enter nest, lay eggs and leave. Male fertilizes eggs and gives some protection to nest, at least when he is in breeding mood. Nest may be community affair to 15 feet across.	Male builds hollow nest of algae, cemented with mucus and about the size and shape of a walnut, with a hole through long diameter. Male drives female into nest and she lays eggs, which he fertilizes, repeating process until nest is filled. Eggs .1 inch in diameter. 300 eggs per female. Guarded by male for 10 days.
ECOLOGY	Goldfish young mature the second year. May breed until 9 years old and may live to be more than 15 years old. Serve the role of general scavenger but do well in clear water. Best in water containing lime, and between 55° and 70°F. In commercial ponds are reared for market at a considerable profit.	Zebras should be reared in tanks holding 20 to 30 gallons of water with one female and 3 or 4 males, even though one male may follow a laying pair and eat eggs as they are dropped. Young are fed on infusoria and brine shrimps at first, but at 3 weeks may be fed regular dry fish food.	Females rarely exceed 6 inches in length, and one or more males may compete for favors. Eggs become buried in sand and gravel, in part because of persistence of male to build his nest larger. Food is largely small aquatic insects, crayfish and small fish. Take same food that trout favor. May take fly.	Young sticklebacks are about ⅛-inch long, but may triple size in 6 weeks. Breed at one year and probably die at 18 months or earlier. Best temperature for activity is about 72°F. Male will defend nest, eggs and young against much larger fishes. He will remain in hole in nest guarding his family.
ECONOMY	Management in ponds calls for using mixture of 2/3 sheep manure to 1/3 superphosphate fertilizer, which encourages growth of aquatic animals and plants that provide rich food for goldfish. Illegal to free them in some bodies of water, or to use them sometimes as bait minnows in trying to catch game species.	One female commonly lays more eggs than a single male is capable of fertilizing. Spent females should be removed to original aquarium. Young may reach a length of 1 inch in 6 months. These minnows are not too closely related to the majority of tropical aquarium fishes.	Not a desirable fish in a trout stream because of competition and because of nuisance to fishermen, who prefer other species. It is one of the best bait minnows because of its hardiness after being hooked. In an aquarium it survives difficult conditions and remains active when other species quiet down.	Food, of course, all sorts of small animals suitable in size. Sticklebacks are useful insect destroyers in the wild, and most useful aquarium fishes because of habits, but do not do well with other fishes in aquarium because of pugnacious habits. May be taken in dip nets drawn through water weeds.

SAILFIN KILLIFISH, MOLLIE *Mollienesia latipinna*	MEDAKA, RICEFISH. GEISHA-GIRL FISH *Oryzias latipes*	AMERICAN FLAGFISH *Jordanella floridae*	GUPPY, RAINBOW FISH, MILLIONS FISH *Labistes reticulatus*	SWORDTAIL *Xiphophorus hellerii*
Length to 4 inches. Olive, dotted with brown on sides. Tail with iridescent light blue markings. Dorsal fin of male as wide as the body, to 1 inch, when expanded in courtship; more showy than in female. Anal fin of male an intromittent organ. One in several million may be all black.	Length to 1¾ inches. Head pointed. Tail square-tipped. Mouth small. Pectoral fins long and pointed, particularly in male. Two color forms; one, silver gray, the other orange-yellow with silver-green on abdomen and eyes. Male with notched dorsal fin near base. Female duller than male.	Length to 3 inches. Male mottled blue and reddish-brown, with lines of steel-blue down scale rows, with intermediate stripes of gold or green. Dorsal fin large. Female with rectangular brown spot beneath dorsal, light brown splotched irregularly with dark brown. Dorsal spot darker in female than in male.	Female to 1½ inches long, male to 4/5-inch. Female heavily mottled. Male showier, with erect, flaglike, pointed dorsal fin and swordlike anal fin. Male silvery-black, marked conspicuously with red and blue. Male much more slender than female at all times.	Length to 3 inches for female, to 2½ inches for male. Both are a gleaming blue-green on the sides, with horizontal orange or red bars from gill covers to the tail. Male has long, swordlike extension at bottom to 1 inch long. This is orange and green, or yellowish with a black border.
Order Cyprinodontes. Family Cyprinodontidae. Native of coast of Gulf of Mexico and of northeastern Mexico. More peaceful than nervous, high-jumping *M. sphenops*. In Florida sailfin is called mudpusser and may be common in suitable waters around Miami. Found in fresh, salt, brackish, or alkaline waters.	Order Cyprinodontes. Family Cyprinodontidae. Native of China, Japan and Korea. Name *Oryzias* refers to rice *Oryza;* "latipes" refers to resemblance of anal fin to a broad foot. Anal not modified into an intromittent organ as in the "molly."	Order Cyprinodontiformes. Family Cyprinodontidae. Native of Florida, where it lives associated with crowded plants, even where surface may be covered with the floating liverwort, *Riccia*, and the underwater bladderwort, *Utricularia*, which incidentally also feeds on small animal life.	Order Cyprinodontiformes. Family Poeciliidae. Native of Venezuela and Trinidad area, but introduced as a mosquito fish in many areas, and one of the commonest of tropical fishes in home aquaria. May survive temperatures ranging from 65 to 80°F., but does best above 70 and below 80°F.	Order Cyprinodontiformes. Family Poeciliidae. Native of Mexico. Male guppy has soft membrane on intromittent organ; the swordtails have 2 hooks on anal fin and the platy has but one. The platy and swordtail may be hybridized with relative ease and success.
Male courts by fin display and pursuit. Eggs fertilized in female, developing there 6 weeks to 6 months. Brood may number 100, or even to 231. Adults usually do not eat own young. Young begin eating water fleas when born, well developed at birth. Breed at 3 to 6 months. Young of black may be light to 1 inch long.	One male may serve many females. Female may lay 1-80 eggs daily during season. Eggs 1.27 mm. in diameter, hang outside female to 5 hours or stick in bunches to plants. Fertilized as leave female. Incubation to 1 or 2 weeks. Eggs and young not eaten by adults. Parents fed live food are best.	Male may clear sand below breeding spot. Mates do not fight each other or eat young. Managed pair are fed nourishing food 2 weeks and kept separate. Put in bright tank with vegetation, eggs are laid and fertilized on plants at 70-75°F. In 5-6 days young drop to sand nest on bottom and male may protect.	Male fertilizes eggs inside female. One mating may produce 4 lots of young at monthly intervals. Raising temperature induces breeding behavior. 20 to 60 young born alive every 4 to 6 weeks in season but often fewer. Young mature in 3 months. Young must be protected from adults by traps.	Breeding tanks, held at 72-76°F., held 1 male to 4-6 females. Male courts female, swimming forward and backward. May produce 10 to 100 young every 4-6 weeks, separating females when young show and putting pair back together 1 to 2 weeks after the bearing. Young mature at 9 months.
Aquarium should be treated periodically with salt, adding 1 teaspoonful per day for 3 days. Gravid females should be kept in plant-crowded tank of 10 gallons or more. Temperature should range from 70 to 80°, with best at 73°F. Gravid females should not be handled unless necessary.	Aquariums should be at least 1 gallon per pair at 40 to 80°F., but best at 60-70. Breeds at 64-68°F. Fry shift more or less for selves, but should have plant shelter to keep under protection in emergencies. Omnivorous, peaceful, high-jumpers, hardy and popular over a wide area of America.	Common practice is to bring pair together for a day, then separate them and remove egg-laden plants. Then bring together with fresh plants and repeat. Males vary in protective behavior so far as building nest and protecting young are concerned. Young are fed on water fleas, Daphnia, as soon as hatched.	A litter yielding 15 females a month potentially might yield 2,244,600 young a year, but young must be protected by falling through mesh to areas not accessible to adults. Guppies are normally peaceful aquarium animals and are probably the commonest of aquarium "live-bearers."	Sexes should be kept separate, as soon as they may be distinguished, until they are to be bred. Old females, strangely enough, may develop anal fin somewhat resembling that of the male. Young are fed on finely crushed dried foods at first, but may feed on living forms at an early age.
Popular aquarium fish. Eat algae, or may be fed finely chopped lettuce. Black mollies popular and one variety with orange border on black dorsal is most to be desired. Change of water may hasten birth when female shows dark spot near vent, but ordinarily females should be handled little at this time.	Popular as aquarium fishes and important in studies of genetics. Because of omnivorous habit require less attention than many with specialized food habits. Because of hardiness and general beauty are popular in public exhibitions featuring aquarium life. Useful insect destroyers.	Popular aquarium fish. May be wild in disposition. Name comes from supposed resemblance to stripes on American flag. Interesting to watch male protect nest and fan the eggs to keep them free from sediments. Have some value as destroyers of insect larvae and other water animals.	Important mosquito fish in areas where small ponds may yield great numbers of the pests. Also popular with geneticists, in part because of great fecundity, both in numbers of individuals and in large numbers of broods per year. Also popular because easy to raise.	Popular aquarium fishes of great interest to geneticists, who experiment with crosses and so forth with swordtails, platys, guppies and other related species and genera. In some crosses the males may be sterile while the females may become fertile.

NAME SCIENTIFIC NAME	PLATY, MOONFISH, RED MOON *Platypoecilus maculatus*	MOUTHBREEDER *Haplochromis multicolor*	SCALARE, ANGELFISH *Pterophyllum scalare*	CHOCOLATE CICHLID *Cichlasoma coryphaenoides*
DESCRIPTION	Length to 3 inches, with female about twice as long as the male. Variable from light gray with tail crescent to red, yellow or black, with a velvety blotch or pair of spots at base of tail. Males usually have more than 3 black, vertical bars on body. Fins plain, or whitish, or opalescent along lower edges.	Length, female to 3 inches with male somewhat shorter. Light brown to yellow, the male sometimes with red spot at end of anal fin. Sometimes with regular dark, vertical bars and with interrupted dark, lateral stripe. Dorsal with dark band with pale blue band beneath and this above a yellowish-brown band.	Length to 8 inches, thin and high, often being higher than long, measuring from fin tips or tail and snout. Marked with dark, vertical bands over a silvery base. Bands may disappear in fish deprived of protective plants. So thin can hide behind or between plants. D. XI-XIII, 23-27: A. V-VII, 24-29.	Length 8 inches. Light to dark brown with metallic-violet belly and dark cross bars and a blackish blotch on the side. Eye iris golden. Fins brown. Dorsal red-edged. Tail with 2 light, vertical bands and dark border. Male often with lump of fatty tissue in front of dorsal fin.
RANGE AND RELATIONSHIP	Order Cyprinodontiformes. Family Poeciliidae. Native of Mexico and Guatemala in waters of the Atlantic Slope with a number of subspecies, only *niger* being found wild. Other subspecies are developed with captive fishes in aquaria, apparently.	Order Perciformes. Family Cichlidae. Native of Egypt. Some 20 species in this African genus, with two well known as aquarium species. Of these *H. moffati* is nearly twice as long as *H. multicolor*. *H. multicolor* from lower Egypt to Uganda and German East Africa; *H. moffati* in upper Congo tributaries.	Order Perciformes. Family Cichlidae. Native of Amazon and Orinoco rivers, with a number of varieties developed by managing breeders. Name *Pterophyllum* refers to the leaf-like fins, and *scalare* refers to harsh outline of spiny portions of dorsal and anal fins.	Order Perciformes. Family Cichlidae. Native of Brazil, with the genus found from Mexico, through Central America into much of South America, varying greatly in size and shape but having 14-19 dorsal spines and 7-15 dorsal soft rays without notch between and 4-12 anal spines and 6-14 soft rays.
REPRODUCTION	Young are born alive with 10 to 280 in a brood and with new broods produced at intervals of about 6 weeks, or maybe as far apart as 3 months. On rare occasions, time may be shortened. The young fishes mature in from 3 to 8 months. Young of different sexes ordinarily not easily distinguished.	Eggs laid in depression in sand, and after fertilization are taken into mouth of female and incubated for about 2 weeks, during which time she cannot eat. Young may remain in mouth a few days after hatching, or may stay to 3 weeks. Mature in 1 year. Incubation and protection of young may be taken over by male.	Hard to breed but may function if left undisturbed; favor slightly acid water. Female puts eggs on smooth surface or plants, there fertilized. Eggs stuck on vertical surface in face of fighting enemies. Eggs laid in rows, hatch in 8 days and are incubated and protected. Reach maturity in 1 year.	Before breeding, parents dig nest hole in sand near flat, light-colored stone. Female lays few eggs on stone and they are fertilized. Repeated until to 2000 eggs are laid. Parents join in fanning and removing dead eggs. Hatch in 4 days and are placed in sand nest. Yolk sac absorbed in 4-10 days.
ECOLOGY	Peaceful fishes that feed on algae and do not tear the large plants in an aquarium as do some species. Hardy under most conditions. Favored temperature is between 65 and 80°F. Platys may be crossed with swordtails, as has been suggested. Some 50 aquarium varieties are recognized in trade.	Spawning may be induced without change of temperature or increased aeration of water. Best temperature is 70-90°F. In aquarium management it is common practice to remove male from aquarium when the female has eggs or young in her mouth during or after incubation.	Favored temperature is 75:90°F. Introduced to England from about 1909. Nocturnal in habits. Eggs would drop to bottom if not stuck on support. Particular about water during breeding season, and unless it is right breeding will not take place. Favors crustaceans for food, or may eat worms.	Young are attended until they are ½-inch long, then parents may eat their own young even after a long period of great care. In the wild state these fishes may kill each other. Favored temperature is 70 to 85°F. Female lays eggs in unique form in circles around the first egg attached to stone.
ECONOMY	Popular aquarium species, appearing in forms that are red, metallic blue, red with black marks, pale yellow, deep orange, plain brown, gold or mixed. The gold platy was introduced into the United States about 1921. Its color may vary from red-yellow to blood red without black spots or markings.	A popular and tremendously interesting aquarium fish. The mouth breeding habit is not, however, limited to this species. Even the American catfish may match this behavior at times and under certain conditions. Usually female lighter, with less brilliantly colored fins.	A beautiful, peaceful, popular aquarium fish with close relatives that are excellent food fishes even though these are surprisingly warm. Must have protection to survive in northern New York in early September. Price of these fishes has dropped rather consistently recently.	Popular aquarium fishes but attempts to breed them in aquaria are usually futile because of killings of adults, or of the eggs or young. Because of this attempts to breed the fish should be carried on in aquaria not shared by other fishes, but the complicated story is so interesting that it is worthwhile.

POMPADOR FISH, BLUE SCALARE *Symphysodon discus*	SPLENDID FIGHTING FISH *Betta splendens*	THREE-SPOT GOURAMI, HAIR-FIN *Trichogaster tricopterus*	STRIPED GOURAMI *Colisa fasciata*	PARADISE FISH *Macropodus opercularis*
Length to 8 inches. Golden-brown with vertical bars of deeper brown. Dorsal and ventral fins of blue-green. A blue-green sheen all over the body. Teeth confined to forward part of each jaw, differing from angel fish, *Pterophyllum*, in not having teeth on sides of jaws.	Length to 3 inches. Grayish or yellow-brown with dusky longitudinal bands. Female paler, often with cross-bands. In breeding season male has red-brown back, reddish below, streaked with green, red, yellow and dark blue with metallic green dots all over body. Dorsal blue-green with stripes. Anal red or blue.	Length to 5 inches. Distinctive because first ray of ventral fins is a long filament. Variable iridescent silvery-olive with darker back and lighter beneath. Oblique dark crossbands on head and body. A round, jet-black spot on side and another at base of tail. Fins light greenish-yellow.	Length, to 4 inches. Ground color brownish-yellow to olive, suffused with sky blue. Red or orange and blue diagonal bars from back to anal fin. Fins sky-blue with bright red margin. Dorsal fin spotted with red and blue and with black and yellow-gold spots and bars on softer parts. Female duller.	Length to 5 inches. Gray to greenish-brown, with upper parts before the dorsal mottled with black, blue-green and red cross bars. Fins reddish-brown with dusky dots and fine stripes bordered with pale blue. The long spine of the ventral fin is orange or red. Females duller than the males.
Order Perciformes. Family Cichlidae. Native of the Amazon. But one species in the genus but is closely related to *Pterophyllum* and *Cichlasoma* and other South American genera. Sometimes called disc cichlid. Name obviously suggested by shape of fish.	Order Perciformes. Family Anabantidae. One of 13 or 14 species found in fresh waters of Malay Peninsula, Australian Archipelago and generally through southeast Asia, Sumatra, Borneo and Java. This species from the Malay Peninsula. Members of family are found in Africa.	Order Perciformes. Family Anabantidae. Four species of the genus in fresh waters of southeastern Asia and neighboring archipelago. This species comes to the west of the genus generally and hails from India. Male has anal fin with a broad orange-red margin and dorsal fin with similar marking.	Order Perciformes. Family Anabantidae. Native of northern India, Assam and Burma, where it lives in rivers and estuaries. Some zoologists place this in the genus *Trichogaster*, which includes the hair-fin of practically the same general range. The family is called the labyrinth fishes or climbing perches.	Order Perciformes. Family Anabantidae. Native of China, Formosa and the neighboring areas of southeastern Asia. This species has black spot on the side of head. In males the dorsal, caudal and anal fins are enlarged. Found in fresh and tidal waters near tidewater regions.
Difficult to breed in captivity. Sticky eggs are deposited on support of plants or solids. Eggs cared for by parent and hatch in 3 days at 84°F. Eggs should be removed from parents' care, aerated mildly in shallow, slightly acid water at 84°F. Need protection a month.	Spawn at 80°F. Male builds bubble nest 1½ inches across and ½-inch thick. Male forces female to nest and squeezes eggs from her. Eggs .3 mm. in diameter. Male puts free eggs into nest. Eggs hatch in 2 days and some 60 hours later young can swim. Male protects young for 10 days. Two weeks between spawnings.	Builds bubble nest like that of fighting fish at temperature of 80°F. Male builds nest but may be assisted by female. Eggs float into nest unlike those of fighting fish, which sink unless placed there. Eggs .3 mm. in diameter. Incubation for 36 hours. Young swim 60 hours after eggs hatch.	Male builds a bubble nest similar to that of the fighting fish and forces female to lay eggs beneath. Eggs float up into nest and are fertilized by the male. In 2 days at a temperature of about 80°F. the eggs hatch, and the young remain in or near the nest for about 3 days protected by male.	Breeds like fighting fish. Eggs .3 mm. in diameter. 100-500 eggs laid at a spawning period requiring 1 hour for the act. Incubation period is for 48 hours and young swim 72 hours after hatching. Spawning takes place at intervals of 2 to 3 weeks. Normally no blue on female and bars indistinct or absent.
Because of large size these fish can hardly be kept in an ordinary tank with other fishes. Because of rarity and difficulty in breeding in captivity price remains rather prohibitive to most aquarium fans, sometimes being offered at $100.	Sexes separated by glass in aquarium until ready to breed, otherwise male may tear female. Breeding furor may last 2 days. Eggs sand-colored so bottom should be sand free or they may get lost. Young feed on infusoria and reach mature development in 9 months. Temperature should be 70-90°F.	May spawn at 2-week intervals, taking 3 hours for the spawning act and producing 100-500 eggs per spawn. Young mature at 6 months. Favors temperature of 60-90 but best at 73-75°F. Normally peaceful but may unexpectedly attack other fish. Require tank of 5 gallon capacity or larger.	In practice the female is removed from the aquarium immediately after the eggs are laid, and the male about 3 days after the hatching has taken place. Ordinarily these fishes are peaceful and are usually timid in the presence of other species, but in courtship the behavior is really rugged.	Very hardy species, surviving at temperatures from 50° to 90° but at best from 73° to 75°. Breeds between 78° and 82°F. Favors live food but can survive on dead material. May survive in dirty water that would be fatal to many aquarium fishes. Should have a tank of at least 5 gallon capacity.
Value is based on rarity because there are other commoner fishes of equal interest and of greater beauty that are available. Could one solve problem of raising them cheaply in aquaria a good profit could be had until the practice were generally known.	In part because of spectacular courtship display, and because of bubble nest and great beauty and activity, this is and will always be a popular aquarium fish. The related perugia or red betta is shorter and even more brilliantly colored than the splendid fighting fish.	A popular aquarium fish costing in the neighborhood of $1 a pair. Eats both plants and animals and is relatively hardy when contrasted with other fish of similar habits. The species name *trichopterus* refers to the hairfin character of the ventral fins.	Popular aquarium fishes because of brilliant coloration, normally peaceful habits and interesting courtship and breeding behavior. Details of courtship and parental care are essentially the same as those given for the fighting fish in an earlier column.	Popular and most attractive aquarium fish of the bubblenest-building type. May attack and injure goldfish that may be in the same aquarium, tearing their fins and generally making them unattractive and uncomfortable.

(Continued from page 27)

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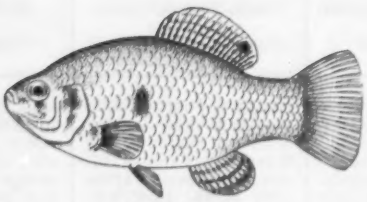
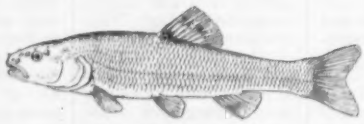


FLAGFISH

GUPPY



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Tide Pool

By HELEN MITCHEL

What depths they knew, these tide pool waters, torn
From turbulence to find a brief repose.
And to what depths they shall again be borne,
And what grave mysteries they here unclose.
Now let us lean above the pool, perceive
This lucent world. The seas flow out, past our
Concern, but from unmeasured wonder leave
The tranquil coolness of this ocean-flower.

From ancient depths full tides of life arise
And then, to misty shores they move away;
But leave to us these hours when beauty lies
Cupped by the quiet moments of the day.
Then let us know each poignant, still delight
Before the life we know dissolves in night.

Insecticide for the Litterbug

THE character at the right is no gentleman. In fact, he is a noxious, two-legged insect in human form. He strews refuse in city park, at the beach, and on the countryside. He leaves his debris at picnic spot, along stream bank, in national park and forest. He is a thoroughly undesirable individual with the most atrocious outdoor manners. He is fittingly represented as a harmful insect, and what is hoped to be a lethal insecticide for him has been devised in the organization of Keep America Beautiful.

KAB, as it is conveniently called in these days of alphabetical semantics, is a coalition of industry and public service organizations. Historically, the fight against bad manners outdoors has been going on a long time. A quarter-century ago the American Nature Association joined with the General Federation of Women's Clubs to wage an Outdoor Good Manners campaign. Through the years many local drives have been made against litter. More recently the National Council of State Garden Clubs swung into action, creating the character pictured here and pointing the finger of scorn at him. Some State divisions of the Izaak Walton League of America loaded spray guns to point them against this insect, who is pictured in various forms, all reprehensible.

Then, a bit more than a year ago, business developed what is usually known as "enlightened self-interest" in the litter problem. Manufacturers and users of cans, bottles, cups, boxes, wrappers and the like began to realize that used containers bearing their names and strewn on the landscape were bad advertising. They are frank in admitting that they were worried by the threat of restrictive legislation, also. So, in their own interest, and in the country's interest, a wide variety of industrial and business concerns chipped in to create a substantial war chest for the fight against the litterbug.

At the outset, industry realized that it could not, alone, carry the battle. So a KAB Advisory Council representative of groups in the farm, conservation, women's club, youth, recreation, education, sports and related fields, as well as governmental agencies, was formed. As a member, we recently attended a meeting of this committee, at which report of the first year's progress was made, and advice sought for the future.

The inaugural year of KAB has seen remarkable progress. With the hearty cooperation of the Governors, several programs have been organized on the State, county and local level. State administrations well know the cost of collecting and controlling litter, and most administrators are eager for any help in solution of the problem. Of course, the ultimate goal is to have going concerns in every State, all through the list, alphabetically, from Keep Alabama Beautiful to Keep Wyoming Beautiful. To a large extent the success of these State programs depends upon the active participation of the members of the advisory committee organizations.

To aid the grassroots campaign, the New York office of KAB has carefully worked up a kit of material, with information on how to do the job of exterminating the litterbug. Hand in hand with action programs go general public education activity through newspapers and magazines, radio, television, the schools, civic groups, as well as, of course, the large membership of the groups on the advisory committee.

One phase of the campaign, for which a final pattern has not yet been achieved, involves the "litterbag." At the recent meeting of the committee a variety of such bags were on display, but it does not appear to be the desire of KAB to dictate which litterbag should be adopted. Several of the bags designed were excellent, and the ideal bag seems to be one that is sturdy, can be tightly closed in some way, and would be waxed or otherwise treated to contain moist refuse. Litterbags would carry on them a message about the proper disposal of litter and identify the agency, public or private, cooperating in the program. Litterbags have been successfully used by the National Park Service in Yosemite National Park, the bags being supplied by the concessioner in the park, the Yosemite Park and Curry Company. The Service has found this device such a help in ameliorating the serious litter problem in our national parks that it is going as heavily as it can into the project.

Space here does not permit recounting all the details about the KAB campaign, but interested individuals and organizations may obtain further data from Keep America Beautiful, Inc., 100 Park Avenue, New York 17, New York. This undertaking is no "one shot" affair, carried on over a limited period. It is recognized that it must go on, year after year, until the American people are aroused to make America beautiful, and to keep it so.

One observation made at the advisory committee meeting was that the recent mass naturalization of foreign-born on Veteran's Day would have provided an opportunity to indoctrinate new citizens against litter. On this another member of the committee commented that most of our new citizens came from countries where concern for the amenities of the outdoors are zealously observed. He suggested that the new Americans would be valuable allies against the litterbug. Can Americans of longer standing be less?

A chinook salmon leaping to clear the falls of the river up which the fish is traveling to its spawning area.

Man and the Columbia's Salmon

By ANTHONY NETBOY

THE Columbia is one of America's major fishing streams. Many species of fish inhabit the river, but by far the most important is the salmon. Columbia River salmon belong to four species. The chinook is not only the largest but is the most abundant and desirable commercially. The other salmon are blueback, silver, and chum.

An anadromous species, salmon spend most of their lives in the salty ocean and enter fresh water only for reproduction. When the adult reaches sexual maturity it is driven by strange and unerring instinct to return to the distant mountain lake or creek where it was born—and to no other. There the female patiently gouges out a "redd," or nest, in the shallow stream bed with rhythmic sweeps of her broad tail and deposits her numerous tiny pink eggs while the male fertilizes them with his milt. The female then covers the eggs with protective gravel to protect them from predators. Soon after both male and female die of exhaustion.

Within about fifty days, the fry emerge. Less than an inch long, they feed from a yolk sac attached to their bodies. Upon reaching fingerling size they begin to forage for such food as insects and minute plants floating upon the ice-cold, bubbling waters. Several weeks after hatching the baby chinooks are ready for their long, arduous, seaward journey. The bluebacks, which spawn only in rivers or creeks tributary to lakes, however, may remain in their natal waters one or more years before starting out on their journey to the sea.

Downstream to the Columbia and the distant ocean is a formidable swim. En route the fishes may have to leap over foaming waterfalls and cascades, avoid irrigation ditches, hurdle man-made dams, and elude numerous predators, such as trout and squawfish—to which tiny salmon are dainty morsels—gulls and terns, and even water animals like mink and raccoon. But eventually the young fishes reach the Pacific. There, with an abundance of food and a favorable environment, they grow rapidly.

Not much is known about the habits of the salmon in the open sea, except that they wander over immense distances. Columbia River salmon have been caught all the way from northern California to Alaska. After leaving fresh water they drop from sight until they are found again in great schools on the offshore fishing banks, moving against the swift current into the Columbia. At this stage, chinook are about four years old and may weigh from five to sixty pounds, although the average fish brought to market is about twenty pounds. Blueback are much smaller, averaging only three pounds.

On their upstream journey the salmon do not feed but live upon the fat stored up in the ocean. And their long migration is so timed that they generally arrive at the old home stream when ecological conditions are most favorable for spawning and egg incubation. Runs of chinook pass through the offshore fishing banks mainly in May and June, and again in August and September. They appear at spawning grounds in the

tributaries of the Columbia and Snake Rivers—sometimes 1500 miles from the ocean—in summer and early fall. If their upriver journey is delayed excessively, by natural or man-made obstructions, they may die without finishing the reproductive process.

The unique life-cycle of the salmon is based upon the use of the broad, fast-flowing Columbia as a central highway from spawning grounds in the tributaries to the Pacific and back again.

For countless centuries the salmon had free use of the Columbia River, encountering only natural predators and Indian fishermen, with their relatively simple gear. Then came civilization. The white man introduced more efficient fishing contrivances, like fixed traps stretching half way across the river and stationary fish wheels, both of which ultimately had to be banned because they limited the escapement and made fishing too easy. At the same time, settlement of the Pacific Northwest brought irrigation agriculture. Water diversions dried up some streams used for migration; irrigation dams blocked others. Deforestation of the green mountainsides ruined watersheds and fish habitats. Power dams built by private utilities permanently barred some rivers to the salmon, while splash dams fashioned by loggers choked off others. Dumping of sewage and factory wastes wrecked water courses favored by anadromous fishes, notably in the Willamette River, which once supported large chinook runs. (This river, however, is being rehabilitated and restocked with hatchery-reared salmon.) As a result of the encroachment of civilization, considerable spawning areas were lost, as the map here shows. Such constrictions, combined with overfishing, were largely responsible for the steady decline in the commercial salmon catch after the middle 1880's, or fifty years before the first dam, Rock Island, was built on the Columbia.

The Columbia River Basin utilization by salmon and steelhead trout. The heavy dark lines show the present areas available for spawning. The lighter dark lines show the migration routes of the fishes. The feathered lines show areas not available, or not suitable for spawning due to man-made conditions. The broken lines show areas never available, or never suitable for spawning.

Rock Island is a relatively low dam, equipped with gently-sloping fish ladders, one on each shore, down which jets of water create an alluring current that enables the salmon to pass over the thirty-foot battlement with relative ease and continue on their way.

When the Federal government, however, began to construct Bonneville dam in 1933, the entire fishing industry was alarmed, for there the athletic fish would have to climb a sixty-foot structure.

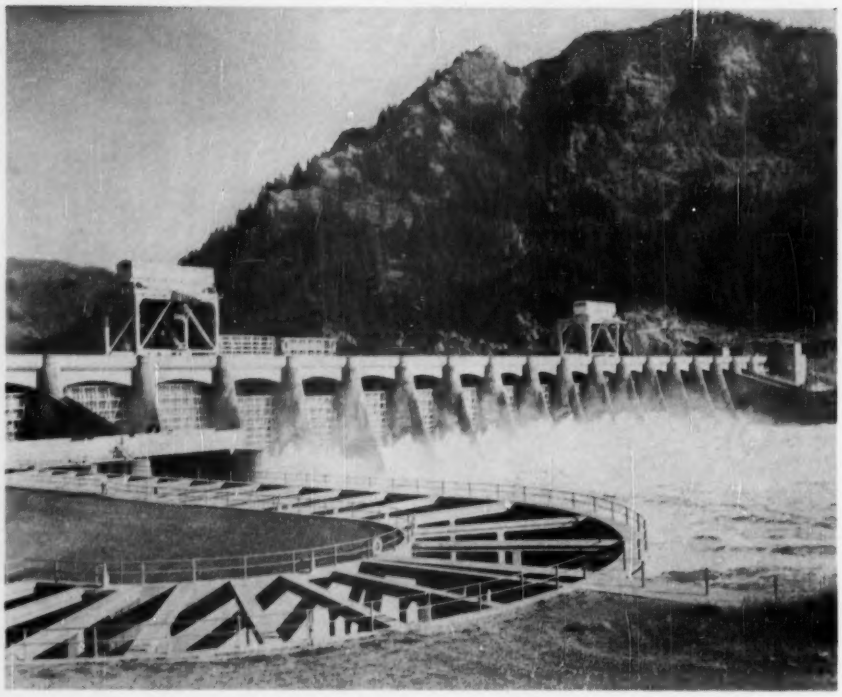
"When Bonneville dam was authorized," said Frank Bell, then U. S. Commissioner of Fisheries, "the President ... sent me a note and requested that I should find some way of getting fish over the dam. I wrote to every civilized country in the world ... and at no place ... could we find where they had passed fish over as high a dam as Bonneville would be."

There were widespread fears that Bonneville, located 145 miles from the Columbia's mouth, would spell the end of the salmon runs in the upper Columbia and Snake River waters, thus wiping out the greater part of an industry capitalized at several hundred million dollars. The best biological and engineering brains were called into play, however, and a unique series of fish ladders and locks, costing seven million dollars, were designed to permit the fishes to pass over the dam.

In 1938, the first year in which the Bonneville ladders

were operated, 470,000 salmon swam over the white counting-boards, where observers wait to tick them off, one by one. In 1939, there were 500,000; in 1940, 740,000; and in 1941, 670,000. The counts proved that the adults, attracted by the powerful jets of water, could easily find the long, curling ladders. But what about the fragile fingerlings moving seaward? They had to pass over the spillway, or swim through generators turning at the rate of 75 revolutions per minute.

It was not till 1942, when the fingerlings that passed Bonneville in 1938 returned as adults, that the effect of the dam on the fishery could be ascertained. That year the salmon count was 625,000, or more than in 1938. And in subsequent years the runs have been equally satisfactory. From 1938 to 1952, inclusive, almost 14 million fishes of all kinds were counted at Bonneville, of which nine million were salmon, an average of 600,000 per year.



The spillway at Bonneville Dam, facing upstream and showing fish ladders on the Washington shore (left) and Oregon shore (right).

Undoubtedly, there is a certain amount of mortality. Some spawners mill about at the base of the spillway, fighting the current until exhausted. Large dead salmon are often seen floating below the dam. But the ratio of these fatalities to the total runs is unknown.

Likewise, fingerlings are killed in the hazardous passage through the turbines, or are drowned against the stationary fish screens. Exhaustive attempts to find a quantitative measure of this loss have been unsuccessful.

From all the available evidence, it is apparent that Bonneville Dam has not appreciably injured the fishery. As Albert M. Day, former director of the Fish and Wildlife Service, told a Congressional appropriations committee in 1953: "Past experiments and experience have shown that adult salmon can successfully negotiate a dam the height of Bonneville .... Adult fish continue upstream through Bonneville Lake, where the current is much reduced, and the young fish pass over the dam and through the turbines with some, but not excessive, loss on their way to the sea."

At Grand Coulee, completed in 1940, the largest dam in the world, a 350-foot rise from tailrace to forebay level precluded the successful migration of fishes. But the amazing homing instinct of the salmon gave imaginative biologists an opportunity to try a large scale experiment in relocating the runs that normally came so far up the river.

The fish were trapped at Rock Island Dam, 150 miles downstream, and hauled in tank trucks to holding areas on Icicle Creek and the Okanogan, Methow, Entiat and Wenatchee Rivers. These waters were cleared of obstructions, including small dams, or were equipped with fishways. Irrigation ditches were screened. At Leavenworth, Washington, the Bureau of Reclamation built the world's largest salmon hatchery to provide additional breeding stock, with substations at Entiat and Winthrop.

The delicate process of transplanting the fishes to their new spawning grounds was started in 1939 and completed in 1943, long enough to cover the life cycle of the species. Nothing like such fish salvage operations had ever been undertaken anywhere. The bulk of the transplants were bluebacks, running in the neighborhood of 20,000 a year, augmented by up to 13,000 chinooks. Since, with few exceptions, the blueback spawned in lakes above Rock Island, almost the entire run of this species was involved.

The question was whether the full-grown offspring of the transplanted adults would return to the gravel beds where they were hatched, or would they vainly attempt to move on to their ancestral homes above Grand Coulee?

In the spring of 1944 the biologists waited with some trepidation for the runs to begin. They watched the silvery fish proceed upstream in the river, mile upon mile. And lo! after passing Rock Island they disregarded the open river and turned into the tributaries; into the Wenatchee, Entiat, Methow and Okanogan where they were born. Only half a dozen individuals

were seen below Grand Coulee. And they continued to return to their new homes ever since, both blueback and chinook. Rock Island counts since 1944 show that chinook runs have been only slightly less than before Grand Coulee choked off the river, while blueback runs have been larger. Indeed, the Oregon Fish Commission noted, in its biennial report for 1953, that "the run of blueback salmon past Bonneville dam reached 185,000 (in 1952)—compared with 131,000 in the previous cycle. The run furnished both the most productive fishing and the best escapement of recent decades."

In 1954 the center of interest shifted to McNary, the newest Columbia River dam. Located 292 miles above the mouth, McNary is among the largest dams in the United States, with a ninety-foot rise between forebay and tailrace. Because salmon have never been passed over so high a dam—fifty percent higher than Bonneville—its $21,000,000 fish facilities were even more carefully designed than Bonneville's. There is a series of curling ladders, each thirty feet wide with pools twenty feet long and a slope of one foot in twenty. An auxiliary water supply creates a current powerful enought to attract the fishes. As at Bonneville, there is a fish lock that will be used only if the ladders prove inefficient.

McNary's spillway gates permit the discharging of the river's flow midway instead of under the bottom, thereby lessening the hazards from change of pressure for the fingerlings heading downstream. However, since water pressure and velocities are generally about fifty percent greater than at Bonneville, the quick passage through the spillway or turbines will offer an even greater test of the sturdy fingerlings' endurance. It takes them about a minute to swim through the intake structure of the power house, but the critical moments are those when they are swept through the revolving propellers of the turbines.

McNary fishways, one-third of a mile long on each shore, were opened last spring. As of July 26, 1954, the counts at McNary were 104,000 chinooks, 85,000 bluebacks and 9900 steelheads. This represented about fifty-one percent of the chinook run at Bonneville (150 miles downstream), seventy-one percent of the blueback count, and thirty percent of the steelhead count. The chinook run past McNary is well within the estimate made before its ladders were opened. The difference in the counts at the two dams, allowing the salmon ten to fourteen days to make the journey, is accounted for not only by possible spawning along the many inviting sand bars and creeks between Bonneville and McNary, but by migration to sqawning grounds in the four major rivers entering the Columbia from the Oregon side (the John Day, Deschutes, Umatilla and Hood) and four in Washington (Klickitat, Big White Salmon, Little White Salmon and Wind). Indian fishing is at its lowest at Celilo Falls during spring and summer because they are partly inundated by high water.

All phases of McNary's fish facilities are functioning as planned and there is reasonable assurance that the salmon can negotiate this hurdle with relative ease—contrary to what some alarmists have predicted. The real test will come in four years, when the offspring of this year's salmon runs have passed through McNary (and also Bonneville) on their downstream journey, and returned as husky adults moving toward their upriver spawning nests.

Meanwhile, another mammoth dam is rising on the lower Columbia—The Dalles, situated 47.5 miles above Bonneville and 100 miles below McNary. The fishing industry did not offer serious objections to this project partly because its reservoir will flood out the treacherous cascades at Celilo Falls, which are a serious barrier to fish, and partly because the Indians who have treaty rights to fish at this point (and nab a large proportion of the salmon passing Bonneville Dam) will be permanently removed from the scene, despite their treaty rights.

Ladders and other fish facilities at The Dalles, costing $32 million, will be similar to those at McNary. The total lift will also be ninety feet.

Although man has to some extent changed the age-old migratory habits of the salmon, the future of this great fishery is by no means assured. Available evidence fails to yield any reliable indication of the effect of multipurpose structures on the salmon population. Yet the industry's opposition to additional dams on the main stem, and some of the tributaries, understandably continues. It is argued that a *series* of dams on the Columbia and Snake would reduce fish numbers in algebraic ratio. This argument has already delayed construction of the Federal Ice Harbor Dam and prevented the building of Portland General Electric Company's two dams on the Deschutes, even though their power is urgently needed. Two decades ago, it was said that dams were blocking the fishes; now it seems that the fish are blocking the dams.

Unquestionably, if most of the proposed structures are built on the Columbia, Snake, Clearwater and other rivers, the difficulties thrown in the path of the salmon on their ancient highway to the sea will be greatly augmented. There is relative confidence among biologists and engineers that adults can probably be passed over a series of high dams with small loss, but what about fingerling mortality? Few presume to guess.

When all the projected dams are in place, from Grand Coulee to Bonneville, the river will be converted into a series of pools or lakes in which temperatures, currents, and other ecological conditions will be much less favorable to anadromous fish than before civilization came to the Pacific Northwest. Spawning beds in the Columbia will be flooded out. Man will have radically altered the conditions of survival for a unique and hardy ichthyological species.

While the controversy of fish versus dams rages, biologists are searching for (Continued on page 52)

Harold Bryant, Pioneer

By ANN AND MYRON SUTTON

In 1950 General Eisenhower visited Grand Canyon National Park, where he was shown about by Harold Bryant, the superintendent. Many notables were his guests, including Arabia's late King Ibn Saud, the Shah of Iran and Grand Duchess Charlotte of Luxembourg.

AGAIN this year attendance records at Nature camps, parks and field stations from coast to coast will likely be shattered as a new surge of neophyte naturalists takes to the woods. And, now more than ever, increasing demand for field trips, lectures, self-guiding trails and campfire talks focuses on the field naturalist, whose job of catering to the unpredictable whims of the traveling public is a complex and delicate one.

Knowing about Nature is one thing; talking about it is another. No one can deny that it takes versatile know-how to describe a fossil brachiopod, a butterfly nymph, aspen leaves, an ant-lion pit, a formation of cirrus clouds, and the flight of a woodpecker—all on one trip. It also requires a special ability to make wildlife *live*, to point out Nature's absorbing dramas in such a way that even purely lay audiences will come back for more. To do so the naturalist makes use of *interpretation*, the science of bringing lofty naturalism and pure, high-worded research down to earth.

Today interpretive activities are so widespread that it is difficult to realize that thirty years ago they were almost nonexistent. In that relatively short time Nature recreation has mushroomed, in no small measure due to one man, a leading ornithologist whose pioneering has resulted in trailside interpretation being introduced to millions, and whose inspiring story is a narrative of dedicated public service.

This man is Harold Bryant, who grew up in California's sun-drenched land of oleanders and orange blossoms, in the days when Los Angeles could remember itself as a lazy Mexican plaza. He graduated from Pomona College, taught science for a year, then went on to the University. It was while he worked on his Master's Degree that trouble began brewing in California politics.

On January 11, 1909, a bill was introduced into the State Legislature amending the penal code to withdraw meadowlarks from the protected bird list. This ominous piece of legislation well-nigh succeeded, for the Senate finally turned it down by a margin of only five votes. The issue pointed up what State Fish and Game Commissioners had long known—that unless someone backed up protection forces with concrete facts and figures, California's songbirds were doomed.

That was Harold Bryant's chance. Awarded a research fellowship in the winter of 1911, he set to work finding a scientific answer (if there were one) for growling farmers and fruit growers, who claimed to be losing crops to meadowlarks, orioles, blackbirds and other species. He examined and tabulated the contents of nearly 2000 meadowlark stomachs, and called in experts to identify what he had found. Then he prepared one of California's first economic bird studies. The ornithologist's thesis pointed out that 63 percent of the meadowlarks' diet was composed of insects *injurious* to crops; proved that they were far more beneficial than damaging; recommended that the bird be retained on the protected list. It still is.

Harold Bryant's meadowlark report earned him a Ph.D., and a reputation as an up-and-coming ornithologist. He accompanied California's agricultural demonstration trains throughout the State, and helped explain modern methods to the farmer and the general public. One day, in the little town of Willows, a group of students boarded the train, guided by their teacher, an attractive young brunette named Amy Morrish. She chatted briefly with Harold Bryant; then, after the demonstration, went back with her pupils to school. As the train left town the young specialist gave it little more than passing thought, for many schoolteachers brought their classes to his lectures. But Amy made an impression, for, three years later, on a ranch near Los Gatos, they were married in a special outdoor ceremony, and returned from a High Sierra honeymoon to a brand new house in Berkeley.

That was 1914, and just the beginning. Appointed economic ornithologist at the University, and game ex-

pert on the Fish and Game Commission, Harold Bryant completed a mountain of research and came out with report after report on squirrels, ducks, insects, snakes, fishes even a little paleontology. He described the habits and food of the roadrunner, and showed Californians how to control the house sparrow. With Joseph Grinnell and Tracy Storer, he authored the monumental *Game Birds of California*, and, all in all, published more than two hundred articles. His University Extension class, "Six Trips Afield," gave outdoor experience to hundreds of professional and business people in the San Francisco bay region, and an outgrowth of one of his University classes became the Audubon Association of the Pacific, an early group of enthusiasts for wildlife.

PHOTOGRAPH BY MYRON SUTTON

It was in Yosemite National Park that Dr. Bryant first launched the National Park Service's interpretive service in the shadow of Half Dome.

In the summer of 1917, C. M. Goethe, a Sacramento Nature enthusiast, asked Dr. Bryant to accompany him to Montana's Glacier National Park. All summer long they, with their wives, hiked Glacier's mountain trails and became close friends. Two years later they hiked the trail from Tahoe to Yosemite, and Goethe again noted Bryant's keen perception and contagious enthusiasm for Nature. As a matter of fact, Mr. Goethe, just back from Europe, had observed Nature-study operations there and wanted to try something similar in the U.S. Harold Bryant agreed. Both felt that Nature—and conservation along with it—could best be interpreted along the trails and roadsides. So they started to work.

Dr. Bryant moved his family to summer camp at Lake Tahoe. There he marked Nature trails, conducted field walks and campfire lectures, and entertained resort guests by showing them how to "read the roadside like a book." The project succeeded beyond all expectations, and Stephen T. Mather, first director of the National Park Service, arranged to have this activity moved the next year to Yosemite National Park, where, working with Dr. Loye Miller of UCLA, Harold Bryant developed a Nature guide service that caught on with incredible speed and aroused great enthusiasm.

PHOTOGRAPH BY JIM LLOYD

Harold Bryant, in 1923, examines a coneflower found growing in a Yosemite meadow.

Two field summers, and the concept of trailside interpretation, changed Harold Bryant's destiny. He gave himself over to developing the Yosemite guide service on the theory that discovering Nature's secrets in congenial company was very much like the thrill of self-discovery. "With proper development," said he, "the national parks may become the great outdoor universities for which their superlative exhibits so finely equip them."

Convinced that inspiring the public to observe carefully was far more important than teaching them facts, Bryant and his co-workers offered Yosemite visitors a wide choice of outdoor recreation. These included field trips, lectures, motion pictures and slides, campfire talks, flower shows, even a

rudimentary library. Before long the project became nationwide. Yellowstone received the first officially appointed park naturalist. By 1923 Glacier had inaugurated a Nature guide service in cooperation with Montana State University. Other programs began at Grand Canyon, Mount Rainier, Rocky Mountain, Sequoia and Zion. The American Association of Museums studied the parks and made plans for establishing museums in them. The boom was on, and Nature enthusiasts came flocking into the parks.

When it became evident that there were not enough personnel trained to meet the demand for lectures and field trips, Dr. Bryant organized the Yosemite School of Field Natural History (June 20, 1925) and directed it for the next five years. In addition to all this early interpretive work, Harold Bryant still found time for his positions at the University, where he had since been appointed honorary curator of birds, and the Fish and Game Commission, but it was in the field of Nature education that he made his greatest achievements.

The Bryants in 1919 on a pack trip down the backbone of the High Sierra from Lake Tahoe to Yosemite. They knew well the trails in the back country of California's mountains.

In 1928, the Secretary of the Interior appointed a committee of six, Dr. Bryant included, to make a comprehensive survey of educational and recreational needs in the national parks. Their recommendations, published in a seventy-page pamphlet, were based on inspirational and educational values already to be found in the parks, and called for a program of interpretation that would enrich the knowledge and experience of every park visitor.

This report gave new emphasis to the interpretive program, which grew so big that, in 1930, the National Park Service organized a branch of Research and Education to handle it. Wisest choice for leadership of this new division was obvious, and it was also proper that the man from Yosemite, who had pioneered trailside interpretation ten years before, should direct the national program. Harold Bryant moved to Washington.

There, for ten years, he worked to build a standard of service for all national parks; to provide uniform ideals and objectives that would insure high quality lectures, field trips and campfire programs; he expanded the interpretive division into a full-scale, nationwide operation, and accomplished his mission. And during that time he was elected honorary vice-president of the District of Columbia Audubon Society, and headed the Bird Protection Committee of the American Ornithologists' Union.

Back in the field again, Bryant was appointed Superintendent of Grand Canyon National Park in 1940. During his administration he aided the interpretive program, acquired private inholdings, instituted control of impetuous Colorado River runners and helicopter operators, and guided many world-famous figures about the park. To the park checklists he added two new butterflies, three new birds (pygmy owl, winter wren, Savannah sparrow) and about ten new plants, one of them, *Astragalus bryanti*, named in his honor.

Then, on March 31, 1954, after more than twenty-five years in the Service, Harold Bryant retired. To Service oldtimers, to Arizonans, to the people who had come to know him through the years, it was a significant occasion. Arizona's Governor Howard Pyle, attended the ceremony, at which the Bryants received from their friends a coveted gift—an original Canyon painting by the late Gunnar Widforss.

And, two months later, Harold Bryant was called to Washington one more time, there to receive from the Secretary of the Interior the Distinguished Service Award.

Today, in California's eucalyptus-lined Moraga Valley, just across the hills from Berkeley, Harold and Amy Bryant are settling into a relaxed and easy life. There, beyond the red brick facade and gray path of their new home, may be heard the song of the redwing and the meadowlark. They will never have enough time for the birding, gardening, stamp collecting and camping they are planning, or the plain and simple visiting with friends, relatives, four children and eight grandchildren.

Meanwhile, if Yosemite naturalists point out the burgeoning crimson snow plant, or a flock of waxwings on the banks of the Merced, it will be because Harold Bryant and the others who pushed the interpretation idea ahead never swerved from the high standards of public service. They showed Americans the wonders of a seeing eye and a stimulating brand of wilderness recreation.

Strange Is the Kiwi

By V. MAY COTTRELL

Captive kiwis on a game farm near Napier, New Zealand, are admired by two small visitors. In many ways these birds are quite unbirdlike and when they were first discovered had to be seen to be believed. Today they have become New Zealand's national emblem.

THE kiwi is a sort of composite bird. It seems to have borrowed its head from the long-billed waders, its legs and feet from the domestic fowls and other scratchers, and its useless, immature wings from the ostrich, the rhea, the cassowary or the emu.

So strange did the description of this bird seem, when it was first discovered in New Zealand in the early 1800's, that it had, literally, to be seen to be believed. The first kiwi skin was forwarded to Europe in 1813, and found its way to Lord Derby's museum, where it created a great deal of interest, not to say amazement. Study revealed that it was, indeed, a bird. But it has no tail and no wings with which to fly. Its nostrils are at the tip of its long beak instead of at the base. It has whiskers like a cat; lives in a burrow like a rabbit; sleeps during the day and comes out only at night, like a bat; sniffs like a hedgehog. The kiwi's plumage is more like hair than feathers. In fact, it is an unbirdlike bird.

At a game farm near Napier, New Zealand, captive kiwis made it possible to study this strange, shy bird at close range. There they performed for their interested and admiring public.

The "cast" consisted of a male kiwi, aged about twenty-three years, a hen, fourteen years of age, and their chick. When I visited them they were standing on a wide bench, with boxes of sandy loam within easy reach. They delved eagerly into the deep, sandy soil with their long, sensitive beaks, seeking live worms that had been placed there for them. These they located by means of scent, and perhaps, sound, for the kiwi's hearing is said to be even more acute than its sense of smell. They have been observed in a listening attitude—like a thrush in search of worms—while hunting for food.

The kiwi's sensitive, beak-tip nostrils are protected by a hard, bony overlap. This enables the bird to probe and prod about in soft ground and mossy banks for food—mainly grubs, worms, the larvae of insects and berries, with small pebbles to aid digestion—without danger of injury to its delicate nostrils. However, the eyesight of these birds is so poor as to amount almost to blindness at the distance of a foot, or so, in the daytime, and about six feet at night.

The male kiwi of the mating pair at the farm had been in captivity for eighteen years and was in his twenty-third year when he, his mate and offspring escaped. Kiwis are reputed to have a life span of about twenty-five years. This male bird had been caught at Ohurakura and sent to the farm under a special permit and for study purposes. The female arrived at the farm some seven years later than the male and when she was only about two months old. She had been caught in a bush fire and ran out of the burning scrub with hardly a feather left on her body, and her feet and legs badly burned. But, as Mr. Robson, the farm curator, observed succinctly, "I patched her up and she soon recovered."

She laid her first egg when she was just four and one-half years old. But kiwis take from five to six years to mature, so, probably due to her immaturity, all the four eggs she laid that year were infertile. From that time onward she laid from one to five eggs each year, all of which were fertile.

But to revert to the unusual characteristics of this remarkable bird, native only in New Zealand, we find that it is minus a tail, and has only tiny, rudimentary wings. These are about an inch long, edged with pin feathers, but useless for flight. By way of compensation, the kiwi can run swiftly on its large, heavily-

The male kiwi takes over the task of sitting on the eggs and will remain on the job for days at a time, usually losing weight during this period of devotion to duty.

clawed feet, which seem quite out of proportion to its size, which is comparatively small. The bird is only about a foot high and weighs less than five pounds when fully grown. The hen birds are invariably larger than the males, which is the only distinguishing feature, as the coloring of both sexes is practically identical. The chicks have no downy stage, but are fully fledged when hatched, and their eyes are open. Their plumage is the same as that of adults, but shorter, and is covered at first with a sort of slime. This flakes off in a few days, leaving the feathers exactly like those of its parents.

Another unusual feature is the bird's long, stiff whiskers at the base of its beak, probably serving a kiwi as cat's whiskers serve a cat. Kiwis are nocturnal. In the wild they sleep in hollow logs, burrows and lodges during the day, emerging at night to hunt for food. The birds make strange, high-pitched, screaming noises at night, sounding something like a long *ke* and a short *we*, and it is from this that the native Maoris derived the popular name. Ornithologists put them in the genus *Apteryx*.

Their breeding burrows, which they excavate with their sharp claws and strong beaks, are usually located among the tangled roots of forest trees, or in sandy banks. They are approached by a tunnel, from two to three feet long in some instances, and the entrance is screened, whenever possible, by trailing vines or underbrush. The inner chamber, in which the nest is built, is about eighteen inches high. The sides and roof are smeared smooth in damp localities, as if they had been plastered. The nest itself is a somewhat elaborate structure, the base composed of twigs and sticks, lined snugly with fern-fronds and leaves.

During his intensive investigation into the life and habits of the kiwis of Stewart Island, H. Guthrie Smith made a careful study of some of their burrows and lodges. He concluded that the nesting burrows are merely temporary affairs, used only for incubation. But the lodges are much more elaborate in character. Judging by their entrance tunnels, which may be from seven to eight feet long, their wide interior side passages and ramifications, and the well-worn paths leading to them, the lodges would appear to be the permanent homes of kiwi families.

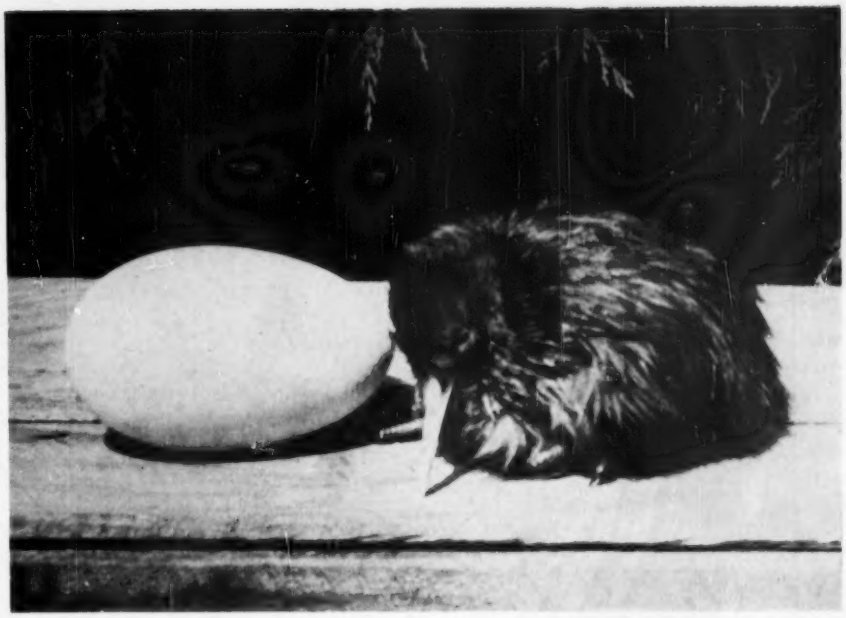
In the wild the kiwi hen lays one or two eggs, more rarely, three. Then her responsibility ceases. The male bird takes over and continues to sit on the eggs in the darkness until they are hatched. This requires a period of from seventy-five to seventy-seven, or even eighty days. The male emerges only to hunt for food, and then only at long intervals. At the game farm the male bird, when sitting, sometimes did not go off the nest for a week at a time. He used to sleep a good deal, even at night. He always lost about two pounds during the incubation period; became savage when disturbed, increasingly so as the hatching time approached. He would hiss and snarl like a cat, and kick out viciously at intruders who approached too closely.

During the last few days of the incubation period the captive female's maternal instincts appeared to reassert themselves. How she knew when hatching was imminent is a mystery, but she would then go at frequent intervals to the box containing the nest and tap all around it with her bill. The male would answer by tapping back from the inside.

When he finally emerged with the chicks the male was savage and unapproachable because of his desire to protect the chicks. Kiwis can inflict wounds with their strong claws. Usually, however, they are docile if you speak to them before touching them.

Chicks hatched in captivity did not emerge for food until the sixth day, their legs not being strong enough to support them until the fourth day. This long fast results in a loss of weight, but once it starts to feed the chick gets through enormous quantities of food. At four weeks, when the average chick weighs about three-quarters of a pound, it will eat a pound and one-half of worms in twenty-four hours.

It is thought that in their native state the birds mate for life, but no definite proof of this is available. The breeding season extends over a long period; observers say from July to February in the North Island of New Zealand, and from October to February in the South. The curator at the game farm said that there were only four months in the year when no eggs were laid by the kiwi hen.



The eggs of the kiwi are large for the size of the bird. They weigh as much as sixteen ounces on occasion, and measure about five inches by three.

The hatching process, as observed in captivity, differs from that of other species of birds in that the kiwi chick does not pip around the inside of the egg. It keeps breaking off small pieces of shell until it cuts a hole about an inch across. Into this it inserts a claw and lifts until the whole thing breaks up. In order to satisfy his curiosity as to whether the kiwi chick pipped with its head under its wing, like other species of birds, Mr. Robson peered through a hole in the shell during the hatching process and there, sure enough, was the kiwi chick with its head still under its tiny wing.

Owing to the size of the eggs, the male kiwi at the game farm experienced some difficulty in keeping them covered during the long period of incubation. The eggs weigh from 13½ to 16 ounces, and measure about five by three inches. They are about two and one-half times the size of the average hen's egg. The male could cope with one egg quite easily by keeping it lengthwise between his legs. A second egg he kept up nearer to his neck, but when his mate was inconsiderate enough to present him with a third, before the others were hatched, it really was a problem.

Kiwis make no attempt to feed their young. But the male bird at the game farm did watch over them and try to protect them from harm, as do the birds in the wild. At the approach of danger he would kick forwards to drive the chicks into the nest. The adult, tame kiwis never went out to feed in the daytime, but the young birds would go out at any time during the day or night.

Male birds indulge in fierce fights, both in their native state and in captivity. They kick forwards at each other, and have been known to lift an opponent five feet in the air with one of their strong, forward lunges. They fight with their bills, too, and make the feathers fly, but their skin is as tough as leather, and even their sharp claws are powerless to rip it during these furious encounters.

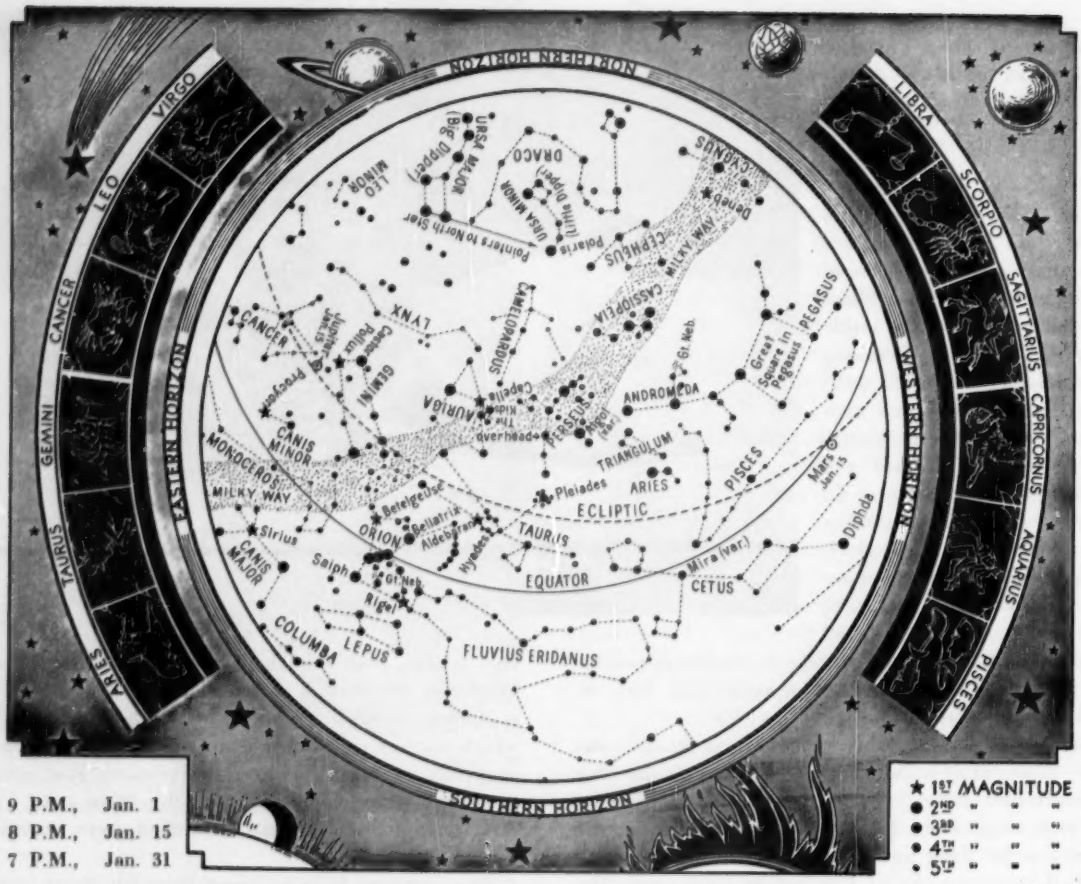
The kiwi is a protected species and it is against the law to kill one at any season of the year. It is *now* illegal to keep kiwis in captivity without a special Government permit.

There are four species of kiwi in New Zealand, three of which belong to the South Island, and only one to the North. The latter is the brown kiwi, known to the Maoris as *Kiwi*, and its scientific name is *Apteryx mantelli*. The others are the southern kiwi, which natives call *Tokeka*, and ornithologists *Apteryx australis;* the large gray kiwi, native name, *Roa*, scientific name *Apteryx haasti;* and the little gray kiwi, *Kiwi-pukupuku* to the natives and *Apteryx owenii* to science.

The southern kiwi is larger than its North Island cousin and its plumage is soft to the touch. It is reddish-gray on the body, streaked with brown, the head and neck being a grayish-brown. The large gray kiwi is tawny on the upper surfaces, tinged with chestnut, mottled and banded with brownish-black, the head and neck a dark, grayish-brown. The little gray kiwi has a head and neck of yellowish-gray, the remainder of the plumage being a light yellowish-gray, mottled and banded with blackish-brown. The North Island brown kiwi has reddish-brown plumage, streaked longitudinally with black. The feathers, which have a fine, fern-like appearance, are harsh to the touch, owing to the shafts being prolonged beyond the barbs.

Pure white examples of kiwis have been observed fairly frequently in the North Island, less perfect specimens being obtained in the South. The pure white feathers of these dainty albinos were much sought after by the early Maoris for use as borders and stripes for the handsome *kahu kiwis*, or kiwi cloaks. These were made by weaving the feathers into a base of dressed flax fibre. These cloaks were among the most treasured heirlooms of the Maoris and could be secured by white people only with the greatest difficulty.

In the early days, before the coming of the white settlers, kiwis were plentiful (Continued on page 52)



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south.

The Heavens in 1955

By ISABEL M. LEWIS

THE exact time of the occurrence of the minimum activity of a sunspot cycle cannot be known until some months, or even a year or so, after it has taken place. In the Publications of the Astronomical Society of the Pacific, for June, 1954, the Summary of the Mt. Wilson Observations of Sunspots shows that in January, 1954, there was only one small sunspot detected in the entire month and that "solar activity was at its lowest level in 21 years". "Similar low activity occurred in December 1933, and in January, 1924," the summary said. Successive dates here are separated by the approximate 11-year sunspot cycle of solar activity, or—from December, 1933, to January, 1954—two such cycles. In each cycle there is always the same gradual increase from minimum to maximum solar activity, and then gradual decrease to the following minimum in an approximately 11-year period.

In February, 1954, a sunspot group of the new cycle was observed for two days. No other groups of sunspots were seen in February. A group of the new cycle can be distinguished from one of the old cycle by the high latitude of the new group, and its opposite magnetic polarity compared to that of the waning cycle. In March solar activity increased slightly, and a second member of the new cycle appeared. In June all indications were that the sunspot minimum had been reached in January, 1954.

Photographs taken of the eclipsed sun during the total eclipse of June 30, 1954, showed the typical sunspot minimum type of corona, with long equatorial streamers and short, bushy, polar rays, parting in opposite directions over the magnetic poles of the sun, as had been predicted.

Not until 1955 is well advanced may we expect any

marked increase in the various types of solar activity, of which the change in frequency of the appearance of sunspots is the most noticeable. The sunspot maximum of the new cycle should be five years, or more, from now.

There will occur, in 1955, three eclipses, two of the sun, and one of the moon.

On June 20 there will be a total eclipse of the sun; on November 29 a partial eclipse of the moon; on December 14 an annular eclipse of the sun. The most interesting and remarkable will be the total solar eclipse occurring on June 20, with an exceptionally long duration of the total phase. The longest possible duration of totality is 7 minutes, 30 seconds, and there is no record of the actual occurrence of any total eclipse with a total phase that long. On June 8, 1937, however, there was a total eclipse of the sun with a maximum duration of totality of more than 7 minutes at a point in the Pacific Ocean. It was observed on Canton Island and in Peru, but at these points the duration was several minutes less. Most of the path of this total eclipse passed over vast wastes of the Pacific, touching only a few small atolls, and, near sunset, a small region on the west coast of South America. Now, after an interval known as the Eclipse Saros—18 years and 11 or 12 days—we have the next eclipse in the long series of eclipses to which the June 8, 1937, eclipse belongs. Successive eclipses in the same series differ little in duration of totality. Sun and moon return nearly to their same relative positions. So the coming eclipse of June 20 will have a long maximum duration of totality, 7 minutes, 8 seconds, approximately, which is within a few seconds of that of the eclipse of 1937. It will, moreover, pass over more land in a densely populated part of the world. Ceylon, and parts of Burma, Thailand, Laos and Indo-China will experience a total eclipse of the sun. Manila and nearby areas in the Philippines will also be within the path of total eclipse.

Partial phases of the eclipse of June 20 will be visible over all of southern Asia and parts of Central Asia and of Japan, also most of Australia and Indonesia. Parts of East Africa, the Red Sea and the Arabian peninsula, and most of the Indian Ocean and the southwestern Pacific come within the eclipse region. The path of total eclipse begins off the coast of Africa at sunrise and ends in the west Pacific at sunset, with totality occurring near noon at Manila.

The partial eclipse of the moon of November 29, 1955, will be a small one. Only one-eighth of the moon's diameter will be covered by the earth's shadow at time of greatest eclipse. It will be visible in the Arctic regions, Europe, most of Africa, Asia, the Indian Ocean, Australia, northwestern Pacific, and Alaska.

The annular eclipse of the sun, which will occur on December 14, 1955, will be one in which the maximum duration of the annular phase will last for 12 minutes, 9 seconds. In this type of eclipse and at the time of the greatest eclipse, within the path of the annular phase, there will remain a ring or annulus of sunlight visible around the eclipsed part of the sun. Unlike the total phase in a total solar eclipse, which can never exceed 7 minutes, 30 seconds, the annular phase of an annular eclipse may last more than 20 minutes in extreme instances. On the other hand, the annular phase of such an eclipse may last for a few seconds, and the eclipse may be total in parts of its path. Such an eclipse is known as a total-annular eclipse.

The annular phase of the eclipse of December 14, 1955, will have a long path, and one several hundred miles wide. This will extend from a region in Libya to the east coast of Africa in Somaliland, then across the Indian Ocean to a narrow strip in Burma, part of Thailand, Laos, Indo-China, and over the South China Sea to Formosa, and to a region near it on the northeast. There the path leaves the earth at sunset. Partial phases of this eclipse will be visible in southeastern Europe, central, equatorial, and eastern Africa, all of Asia, except the extreme northern parts, the Indian Ocean, and Indonesia as far east as about 145 degrees East Longitude. Much of the region of this annular eclipse will also be within that of the total solar eclipse of June 20.

In 1955 Mercury will be at greatest eastern elongation, and most favorably placed for observation in the evening sky in the twilight on January 28, May 21, and September 18. It will be invisible at and near inferior conjunction with the sun on February 12, June 16, and October 13, when it is between sun and earth and passes from the evening to the morning sky. On March 11, July 9, and October 29, Mercury will be farthest west of the sun at greatest western elongation, in the morning sky. Best times to observe this planet are on and near the dates of greatest elongations, for a week or more before and after, when, under good conditions of seeing, the planet may still be seen in the twilight. In 1955, Mercury will be at superior conjunction—with the sun between earth and planet—on April 22, August 5, and December 4. Again the planet is invisible in the sun's rays as it was at the times of inferior conjunction; and for some days preceding and following these dates it (Continued on page 50)

Highway of the Stars

By DANIEL SMYTHE

I stood on Palomar
And saw the galaxies of mist and star—
A rush of incoherent space
With wells so deep no man could guess.
Upon my face
Blew nebulae and planets, meteorites;
And in the dome that darkness dulled,
Beyond the single glass,
The cold, magnetic eye
Awaited, glowering, full
Of all the promises of ways to see
Where light-years pass
On dream-like star-fields of these nights.

The School Page

By E. LAURENCE PALMER

Professor Emeritus of Nature and Science Education, Cornell University, and Director of Nature Education, The American Nature Association

AQUARIUM FISHES IN SCHOOL

ONE of the most used—and abused—teaching devices in the school rooms of the country may be the aquarium. In school after school, the aquarium is an abandoned, dirty, possibly cracked device that clutters up the storage space available to the classroom and is a satisfaction to no one. In many other schools, the aquarium is nothing more than a curiosity of incidental interest to some of the students, or a show piece designed to impress visitors in some way or another. Only rarely is the aquarium used to its best advantage, day in and day out. Most uncommonly is it appreciated for its possibilities. While teachers and students read from books about climates, about biological balance, about population problems, about photosynthesis, and about the food crises of the world of today and of tomorrow, they frequently ignore what the aquarium can do to answer, objectively and most satisfactorily, many of these questions.

It is not my purpose on this page to discuss the techniques of managing a schoolroom aquarium. Something of that nature is given on the pages of the insert in the center of this magazine, or is suggested in the bibliography in that insert. Besides, teachers' guides are generally provided, with directions for stocking and maintaining an aquarium of one sort or another. What I do want to do here is to call to your attention some of the possibilities for aquarium use that seem to me to be generally ignored.

In the first place, an aquarium is a microclimate, a little world in which what you do may determine the success or failure of the plants and animals in that world. If you can yourself learn how to manage that world successfully for all concerned, you should be better fitted to tell others how they may live in other and larger worlds. Teaching is essentially concerned with helping folks, young and old, live in the world that fate may hand to them.

Frankly, I think it is ridiculous to try to maintain a single aquarium in a classroom. I would much prefer two, three, four, or a whole battery of small aquaria, than a single large one. With such a battery you can run check studies in which some critical factor is present in one, but different in another otherwise similar unit. Two aquaria of identical size, stocked similarly, placed similarly, with equal temperatures, may differ greatly in the amount of light present. This amount of light may be changed quickly and easily by some sort of barrier. The conditions may be reversed and the results observed with comparative ease. If, for example, you start with two similar aquaria, with identical temperatures and amounts of water, and let strong sunlight reach one and bar it from the other, you may, with your finger or with a thermometer, measure changes in temperature. You may notice whether water evaporates more slowly in one or the other. Then, by reversing the light situation, you can check on any observation or conclusions you may have made or reached. This may well be a first step in the use of the scientific method.

The chemical nature of the water in two otherwise identical aquaria may be modified by the simple technique of adding small amounts of lime, acid or salt until observable results are possible. There are obvious observations that are useful in understanding what happens when government projects modify the flow of fresh water into harbors, or change the salinity of the harbor waters and the economy and happiness of the human beings who may depend for a livelihood on the plants and animals that favor brackish water.

Stories on the results of pollution are usually illustrated by pictures of fish killed by industrial or domestic wastes. How much simpler and more effective might be the addition of some of these pollutants to the water in your aquaria and observing what happens. It might even be effective to try to maintain a few aquaria in which the water in some was taken from a stream above your local community, and the water in others taken from the same stream below your community, or at least below where it dumps its sewer wastes. Lessons such as this may be too dynamic for safe use in some schools, where politics, rather than common sense, calls the shots. Nevertheless, here is a chance to show what your community does to the water that comes to it and in a way that might well be hard to refute.

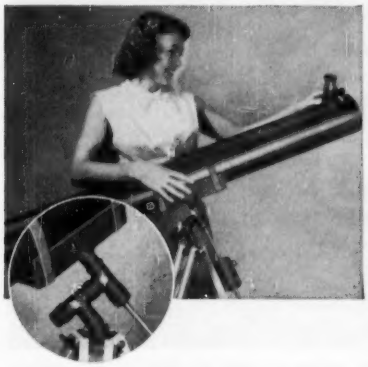
We read in our textbooks about how mosquitoes may be controlled by spraying with oil on the waterways in which they develop. How much more effective it might be to observe what happens to some mosquito wrigglers if oil is put on the surface of a tumbler aquarium on your windowsill. I have seen this mosquito story in plenty of texts. I once edited a movie film for a major educational movie series dealing with this condition. I feel certain that more persons have learned the truth about this situation from seeing the movie, or from reading about it than ever actually observed the death of a mosquito wriggler in a tumbler of water capped by an oil film. I am sure that the tumbler costs less and is a more effective teaching device than the books or the movies, but teachers will persist in doing some things by these less effective means. How many of my readers of this paragraph themselves have seen a mosquito wriggler die in a glass tumbler, and how many have seen this happen in a movie, or read about it in a book, or heard about it in a lecture?

The role of sediments in the economy is often touched upon in school programs, particularly where some emphasis is given to conservation. Why not use your aquarium to observe the effect sediments have on life in various parts of that aquarium. Notice how some sediments composed of organic materials settle to the bottom differently than do sediments of inorganic nature. Notice how sediments reduce the amount of light that reaches the bottom of an aquarium, and consequently affect the prosperity of living things there. Notice how, in the management of farm fish ponds, arrangements are made so that some bottom plants are definitely discouraged from growing by the development of surface organisms that provide food for fishes and prevent bottom plants from growing so that they clog the pond. This whole business of managing the sediments and light in a farm pond may be demonstrated in a few aquaria in your own classroom. I, for one, feel that you have an obligation to give this method a fair trial.

We have suggested lessons based on physics, chemistry and economic biology that might be taught effectively in a schoolroom aquarium. Have you thought about how psychology might be taught similarly? If you ever try to rear tropical fishes in your aquarium you will find that psychology may well enter the picture. Try managing a male fighting fish that you want to breed with his natural mate. The two may well differ as to their preferences as to when mating may take place, and unless they are brought together at the right time you may have a ruined female and a disappointed male. The simple device of separating the two by a pane of glass in the aquarium, and waiting until it is obvious that she is as ready to receive him as he is to meet with her, makes it possible for you to practice a little real fish psychology. You may wish some of your brilliant tropical fishes to display their colors and courtship behavior at a given time and place. Many times a simple application of psychology, involving putting a female in a small jar inside a large aquarium in which there are males, may solve your problems along this line.

I rather doubt if there is any important field of human endeavor that is worthy of presentation in a schoolroom that cannot in some way find illustrative suggestions from an aquarium. This may be a bit far fetched, but I am sure that much that teachers do teach could be taught more effectively if they used fully the aquarium found in the storeroom. Why not fix it up and put it to work?.

★ ★ ★ ★ Shopping Outdoors ★ ★ ★ ★



Palomar, Jr., is the name given by Edmund Scientific Corporation, Barrington 3, New Jersey to its new astronomical, 4¼-inch, reflecting telescope. This instrument features rack and pinion focusing, and an aluminum tube with counterbalancing weight. It has an equatorial mounting that permits the observer to follow the movement of stars with only one movement of the telescope tube. The company will be glad to supply further details.

There are cloak and dagger ideas suggested by the Spy Camera marketed by American Homecraft Co., Dept. N. M., 3714 Milwaukee Ave., Chicago 41, Illinois. This little camera is not a toy, despite the fact that it is smaller than a matchbox. It has a fine f4.5 lens, optical view finder, 1/30-second shutter speed, and takes 8 pictures to a roll of film. Price of this tiny camera is $3.98, and three rolls of film cost 87 cents.

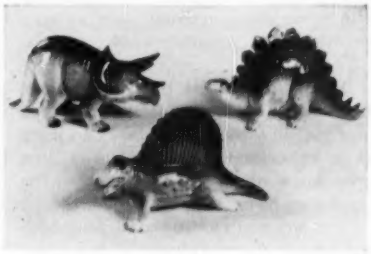
Also in the field of outdoor seeing is the "Turmon" Monocular by Carl Zeiss, announced by Ercona Corporation, 527 Fifth Avenue, Dept. N. M., New York 17, N. Y. This little instrument is not much larger than a matchbox but is a precision, 8 x 21 prism instrument. The eyepiece has a focal adjustment from about 5 feet to infinity, but the monocular can be used as a magnifier for observing objects at close range. It sells for $50.

Imported from Germany is a "Rain-or-Shine" Barometer offered by United Products Co., 9043 S. Western Ave., Dept. GB, Chicago 20, Illinois. It helps one to be his own weather prophet. Framed in cherry hardwood, it has brass fittings and a dome-shaped dial glass for quicker and easier reading. It sells, gift-boxed, for $6.95, including shipping and handling costs.

According to Dorothy Damar, 999 Damar Bldg., Newark 5, N. J., all your parakeet's frustrations and inhibitions will be put to an end by Parakeet Trapeze. Natural born gymnasts and exhibitionists, these birds appear delighted with this opportunity for exercise and excitement. Together with a book on training "Budgie," this gadget sells for $2.98.

"Keep Stake" is a new, three-inch, screw-type earth anchor for staking tents and mooring boats. It is announced by A. B. Chance Co., Centralia, Missouri. The stake is rated for a minimum holding capacity of 750 pounds in average soil.

United Binocular Co., Dept. N. M., 9043 S. Western, Chicago 20, Illinois, calls its new binocular "Whisper More," saying that it weighs but a whisper"" and does "more." This six-power prism binocular weighs in at less than half a pound; has a field of view of 390 feet a 1000 yards. It sells for $27.95, plus Federal tax.



With interest stimulated by the dinosaur articles in our November and December issues, readers will be interested in the little porcelain scale models of Dimetrodon, Triceratops and Stegosaurus shown above. Each is about six inches long and in full color. Individual animals sell for two dollars; a set of three for five dollars. Distributors are Abbeon Supply Co., Dept. N. M., 179-31 Jamaica Ave., Jamaica 32, N. Y., which guarantees these prehistoric representations.

"Hero" is a compact little carbon tetrachloride extinguisher for reduction of the peril of boating fires. It is a pioneer low-priced extinguisher, approved officially in several States. Manufacturers are Bostwick Laboratories, Bridgeport 5, Connecticut. There are no tricky valves to open before this extinguisher can go into action, just lift a bar and it goes to work, shooting a pressurized stream 12 to 18 feet, smothering grease, oil, gasoline and electrical fires. A 16-ounce can, with wall bracket that can be quickly installed, sells for $1.49.

Camera Trails

By
EDNA HOFFMAN EVANS

This photograph of a killdeer on her nest, taken by Fred G. Taylor, Jr., shows excellent detail. It proves the result of interest, skill, patience, and good camera equipment.

THE start of a New Year is the time to look forward, optimistically, to new goals, to worthy ambitions, to hopes and to dreams of better things to come. But, at the same time, such activity should not be confined to wishes, hopes, and dreams. The New Year is also a time to make specific plans and to take definite steps toward transforming those dreams into realities.

A letter I received not long ago from a young man in Tennessee is a good example of what I mean by taking steps toward making dreams come true. Perhaps the road ahead is not as straight, and as clear, and as smooth as one might wish. None the less, the goal is clearly defined, although the route leading to it will have to be charted as it comes.

The young man wrote:

"I am sending two photographs to your magazine for your opinion on my Nature photography. Someday I hope to be a wildlife photographer, and for that reason I have sent them to you, to get your opinion. . .

"This year I graduated from Oak Ridge High School where I served as photo-editor for two years. My interest in wildlife began in Scouting. I have attained Eagle rank in Scouting. I would appreciate it very much if you would help me by giving your opinion of my work. The two photographs enclosed are of a killdeer sitting on her young and a field sparrow approaching her nest. I have a few more photographs which I have taken. . .

Fred G. Taylor, Jr."

The letter, I think you will admit, was a challenging one. It deserved a worthy answer. So, after some delay and a great deal of thought, I answered as follows:

"Dear Fred:

"Please forgive my delay in answering your letter. As I wrote you several weeks ago, I was on the eve of leaving for a western trip, and since I wanted to spend more time than I had at the moment in answering your letter, I wanted to wait until I could give it the time and thought it deserved.

"I thoroughly approve of your determination to become a wildlife photographer some day. By that, I assume you mean that you want to make wildlife photography a full time job—the one by which you earn your bread and butter. If this is the case, the way ahead is long and the turns in it are by no means clearly marked. It is a highly specialized field and a highly restricted one—there are not many places where you can apply for and get a job as wildlife photographer. Nor are there too many markets where you can sell your pictures if you decide to go at it 'free lance.'

"In many cases, photography is a tool rather than a whole job. It is connected with some other activity, such as conservation work, scientific study, or writing.

"Please do not think that I mean to be discouraging. You can do it if you keep your goal in view and are ready to jump when opportunity knocks. And you never know when, or where, or how, the knock may come.

"You say you recently graduated from high school. Do you plan to go to college? If so, look for the departments and the subjects that deal with natural history. These, of course, are biology, forestry, conservation, and some phases of agriculture. The teachers in these fields, knowing your interests, will do all they can to aid you along the road to your goal.

"If you do not plan to enter college, the scientific field (and Nature photography is closely related to science) will be harder to enter. You should approach it from the direction of photographic (technical) skill, rather from that of scientific knowledge. Get all the experience in photography that you can. Perhaps you might work as photographer on a newspaper (this may or may not be a blind alley), or become photographer for a state or federal agency working with conservation, parks, and the like.

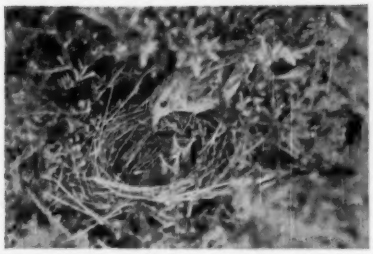
"No matter which line of approach you follow—educational or technical—take all the pictures you can and send them to magazines that you think might be interested. Even though the editors send them back again and again, keep on. The market is not particularly large—those dealing with Nature subjects, and with outdoor activities like hunting and fishing, are the best markets. Study them, see what they use in the way of pictures. You will, of course, find much competition from the few professionals and the many, many hobby photographers in the field.

"Now about your own pictures—I think they show a lot of promise. The killdeer one is much clearer, but the one of the field sparrow shows much more action. I wish you had told me more about the type of camera you used and the techniques you employed, so far as stalking the subject, setting the camera, and releasing the shutter are concerned. How close were you? What shutter speed and lens aperture did you use? Did you take either picture by remote control? Are the prints from the whole negative, or are they blow-ups of just one section? Did you use flash, or not? Until I know all of the above, it is hard to give an accurate appraisal of the pictures. Much better results are to be expected from a versatile camera than from one that is not versatile.

"The prints, themselves, can be improved. The field sparrow is gray, flat, and not 100 percent sharp. I suspect it is a 35mm blow-up. Right or wrong? The killdeer has excellent detail, but the print, itself, looks old and much-handled. Editors like new, crisp, glossy prints. The 5 x 7 size is all right, although some publications still prefer 8 x 10 prints.

"I would like to use your pictures, and your letter, as a basis for a 'Camera Trails' section for I am sure the material would interest many readers. And I would like to tell them just about what I have told you in this letter. . . Good luck to you."

Before long, back came this reply:



This picture of a field sparrow at her nest has lost some detail because it was necessary to set the camera at a greater distance than was the case with the killdeer picture. The picture was taken by Fred G. Taylor, Jr.

"Dear Edna Hoffman Evans:

"I received your letter today and was very glad to hear from you. You asked if I had planned to enter college. I would like very much to go to college but am not financially able. At the present I am employed by Myers Camera Store. I have made application for a photographic school in the Signal Corps and plan to leave in about six weeks. I plan to take every possible photographic opportunity the Army can offer. I hope to gain as much photographic skill and knowledge as possible. When my time with the Army is up I will work towards my goal of a wildlife photographer. . .

"About my pictures, both were taken with a Busch 2¼ x 3¼ Press Camera, the camera has a Wollensak f/4.5 lens with speeds up to 1/400. The film used was DuPont 428, the pictures were taken with the use of a remote cable which works off three flashlight batteries in my flash gun. The cable is about 80 feet in length. In order to get the killdeer picture, I had to lay the camera on the ground because of the nest being there and my tripod would have given me more distance than I wanted. The camera was about eleven inches from the nest and it took at least an hour to get the picture because the bird was awfully shy. I took the picture at 1/100 with an aperture opening of f/11.

"The picture of the field sparrow is not a 35mm blow-up. It was taken at about two feet and didn't cover the film area as the killdeer did. When it was enlarged, a lot of detail was lost and that is the reason it appears to be flat. I used a setting of 1/50 at f/11 to get this picture. You are right in saying that the pictures are much handled; I used them in my Nature and Bird Study classes at Camp Pellissippi. . .

"The bird I would like to photograph most is the yellow-breasted chat. Because of its shyness, I think it would be a great accomplishment to get a good shot of her.

"Three weeks ago I bought a Zeiss Ikon Contessa 35mm which I plan to equip with a remote cable which will work from air pressure, and with it I hope to get some good Kodachrome transparencies.

"Your letter has given me inspiration and boosted my desire to achieve my goal of a wildlife photographer. I expect the road to be hard, but I will try my best.

Fred G. Taylor, Jr."

It is good in these days of television, jet planes, and super-mechanization to find young people who are still interested in killdeers, and field sparrows, and yellow-breasted chats. And, in the long run, I suppose that the attainment of their goals is no more difficult than the attainment of any goal in a restricted and rather highly specialized field. Fred, I think, has the right idea about the photographic training he will get in the armed service. After that, if he wishes, he can take advantage of the G.I. Bill and get college training that will give the educational background that he needs for the full attainment of his ambition.

In stressing college training I realize, of course, that a diploma and a degree do not give the person attaining them a non-stop ticket to success in any field. Nor is the lack of a degree a complete road-block on the way to success. But if one does have the desire to attain a goal in any direction, he is smart if he prepares himself as thoroughly as possible.

One more thought on the subject of goals in the Nature field. Because my correspondent was a young man, my role as adviser was simpler than it would have been had the advisee been a young woman. I know there are some girls who would also like careers dealing with outdoor activities and natural history. But how to reach the goal—that really is a problem. Education helps, of course, and the ability to recognize an opportunity when it presents itself. Most women in the field today—and there are not very many of us—have gotten there by the indirect, rather than by the direct approach. The women who have become museum curators, directors of zoos, conservation experts, and wildlife managers have done so because first of all they could type, take dictation, keep records in order, or perhaps write feature articles. Then an opening occurred, opportunity knocked, and they opened the door.

More and more fields are opening to women every year. But the Nature field is one that is not yet very wide open to women. There is still more truth than humor in the oft-repeated phrase: "If you want to be a naturalist, sister, the best way is to marry a guy who is one."

PHOTOGRAPH MARKET: For photographers who would like to market their pictures, the National Audubon Society has set up a photo and film department in cooperation with the Nelson Doubleday Nature Program. Miss Jane Segnitz, Director, Photo and Film Department, National Audubon Society, 1130 Fifth Avenue, New York 28, N. Y., has been designated as agent to deal directly with Nature photographers through-

(Continued on page 52)

FLORIDA'S SUICIDAL FOREST

(Continued from page 12)

these animals are like no others in the land. Their hoofs are needle-sharp and then can dig themselves out of sight into the ground almost as fast as a man can climb out of a jeep.

There are wild hogs on the Ocala, leftovers from the pioneer days immortalized in the novels of the late Marjorie Kinnan Rawlings. Olson catches them in pig traps on the islands and turns them over to farmers for domestication, or for other practical disposition. Down along the runs otters splash down their slides, racoons fish in the waters, and squirrels scamper through the trees.

Alligators, once almost extirpated on the Ocala, now are coming back in numbers. They are protected until they become more than ten feet long. Other reptiles found here include the cottonmouth, king snake, harlequin and Florida diamond back. This latter snake used to bring a dollar a foot at the wildlife exhibition at Silver Springs. "But," Olson says, "the forest crews took to collecting them and it got so you couldn't put your hand in a tool box without finding a rattler there. So we had to forbid it during working hours."

A curiosity of the Ocala's streams is their population of fish normally found only in salt water. Notably at Salt Spring, you can see the streamlined shapes of needle fish from the far-away Gulf of Mexico, mullet from the coast, and other fishes that surf-casting anglers normally find at the oceanside.

As for insect life, there is a prize called the walking stick. A species of this interesting creature is found only in the sand pine forest, and in the fall you will see the ground dotted with pairs of them, the male carried on the female's back and eaten when the mating cycle ends.

Bird life includes almost every songbird known to the East, in addition to wading birds such as American egrets, blue herons and ibises. White-billed coots and crimson-billed Florida gallinules are numerous in the marshes, while ducks of several species disport themselves along the narrow streams. Eagles and ospreys dot the skies, sending flitting shadows across a forest that is alive with countless flaming cardinals, bluejays, redwing blackbirds, yellowthroats and mocking-birds. Scuttling along close to the earth are coveys of quail, so tame in the recreation areas that they can be fed by hand.

An oddity in itself, this rich population is explained by the fact that the Ocala's climate is midway between tropical and temperate. Thus many of the common creatures from both ends of the Atlantic Coast are found here.

Quite uncommon, however, is the deer herd—for the same climatic reason. In no other of the national forests is the weather so mild that the deer breed and drop their fawns the year around, paying no heed to seasons. A herd of about 5000 thus reproduces here at the unprecedented rate of twenty-five percent a year.

Hunting, plus Nature's limitation upon food and an insect called the screw worm, keep the size of the herd constant. Its behavior and characteristics, however, are so unique that the State of Florida recently assigned a wildlife biologist, Donald D. Strode, to make a study of these deer over a period of several years.

"Ninety percent of the deer I check each year are graded 'good'," says Strode, which indicates an exceptionally healthy herd. "The most serious threat is the screw worm, which attacks deer exhausted by running from the hounds. It lays its eggs in the flesh and literally eats the deer alive, weakening it and making it susceptible to various diseases."

The hunt each year on the Ocala is managed by the State and is one of the largest managed hunts in the country. Restricted from such use is the Ocala National Game Refuge in the center of the forest.

Most visitors see the Ocala from the vantage point of Juniper Springs, a busy recreational area where a concessionaire takes care of the swimming pool fed by the "boil," and where foot and canoe trails lead back into the forest. The twelve-mile canoe trip down Juniper Run is perhaps the finest way to see a cross-section of the land, since it begins in a palm-fringed pool, cuts through a jungle of tangled vines and strangler figs, traverses a vaulting cypress forest and ends in wide marshy meadows surrounded by the pines.

At almost any season, the Ocala is a technicolor forest—a kaleidoscope of golden meadows, red holly clumps, yellow water lilies, green pines and silver waters. It is such a place of beauty that one cannot help but cheer the unceasing efforts of Ranger Olson and his crews to save the forest from its apparent aim—committing suicide.

TITANIUM, FAIR-HAIRED METAL

(Continued from page 19)

resistant metal for piping systems handling sea water, condenser tubes, small propellers, shafting, pump parts, gun shields, and antenna wires.

Also patiently waiting in line are oil refineries, the chemical industry, automobile makers, and even hospitals. Small quantities of titanium have been made available to the latter, where it has proved effective in the making of artificial bones and skull plates.

How would you recognize a piece of this new wonder metal? Well, in the first place, you would never find it in a pure state in Nature, as you might gold, copper, or mercury, for instance. It is always in a combination with other elements, as an ore, either in rock formations or in sand. Pure titanium is a low-density, silver-white metal, between silver and stainless steel in color. One reference book says it closely resembles silicon, but because pure silicon is even rarer than titanium, this will not be much help. If you are not near a museum with a better-than-average collection of metals and minerals, perhaps you will just have to wait until titanium becomes plentiful enough to use in your outboard motor engine and propellor, or portable TV set, or jet automobile!

How long will that be? Maybe there is a clue in a recent ruling of the Office of Defense Mobilization. As of May, 1954, ODM authorized an annual production of 32,000 tons for defense needs, and an additional 3000 tons for new commercial products.

THE HEAVENS IN 1955

(Continued from page 45)

will continue to be too close to the sun to be seen.

Venus, as well as Mercury, will have its elongations, and inferior and superior conjunctions with the sun, and its phases similar to those of the moon. Mercury, however, can make the trip from superior conjunction back to the same position relative to the earth in approximately 116 days. Venus takes about 584 days to make the same revolution in its orbit relative to the earth. In 1955, Venus starts the year as a magnificent Morning Star in the southeastern sky, rising about three hours before the sun. It will be at greatest western elongation on January 25, and it will remain in the morning sky until September 1, when it will be in superior conjunction with the sun and will pass to the evening sky, where it will soon be visible as an Evening Star. Venus will increase its distance from the sun gradually, and will increase in brightness and splendor as an Evening Star, but it will not reach greatest eastern elongation in 1955. Mercury, however, in its swift flights around the sun, will pass *three times* through both greatest eastern and western elongations, and inferior and superior conjunctions with the sun, in 1955.

Mars starts the year in the evening sky, west of the meridian in Pisces, a bright, reddish, Evening Star of first magnitude. During the winter, spring and early summer months it will pass slowly eastward in its orbit, through Aries, Taurus, Gemini, and Cancer, into Leo, remaining in the western evening sky and gradually decreasing in brightness as it recedes from the earth. It disappears in the sun's rays, no brighter than a star of third magnitude, some days before its conjunction with the sun on August 16,

when it passes to the morning sky. By October 15 it will be visible as a Morning Star in Virgo. Mars is now on its long return trip to its 1956 opposition to the sun, and has become as bright as a star of second magnitude, changing little in brightness up to the end of 1955, when it will be visible in the morning sky in the constellation of Libra.

At the beginning of 1955, Jupiter is in Gemini, rising in early evening and visible for the remainder of the night. On January 15 it will be in opposition to the sun and visible all night. It will rise earlier on successive evenings, and, by April 11, it will be near the meridian at sunset and sets at midnight. Jupiter will be in conjunction with the sun on August 4, then passing to the morning sky, where it will soon be visible as a beautiful Morning Star. On November 23 it will rise about midnight and be on the meridian about sunrise.

Saturn, at the beginning of 1955, is a fine Morning Star in Libra, and it will remain in this constellation throughout the year. On February 10 it will rise about midnight and be on the meridian at sunrise. On May 9 it will be in opposition to the sun and visible all night, rising at sunset. It will be higher above the eastern horizon on successive nights after opposition, until, on August 8, it is on the meridian at sunset. It will be in conjunction with the sun on November 16, and will then pass to the morning sky. By the end of the year it will have become a fine Morning Star. Saturn is now a beautiful telescopic object, and has been for some time, as its rings are inclined at a high angle to the earth. The northern side of the rings is brilliantly illuminated by the sun, adding greatly to the splendor of the planet, which is more brilliant than a star of first magnitude.

CONFESSIONS OF A VIVISECTOR

(Continued from page 22)

teaching and research is as nothing compared with the thousands sacrificed for man's food needs every day. Regard the precedent brandings, breakings and castrations of the animals of our fields; their inadequate shelter, food and transport; their death on the abattoir floor. If you have never visited the source of your steaks, chops and bacon, by all means do so. It could make you into an East Indian.

Thus it comes about that even a small improvement in breeding and butchering practices does vastly more to reduce the total of animal suffering than any periodic raid on the medical laboratory. What has been called the greatest forward movement in the prevention of cruelty to animals came to public notice in 1952 when the George A. Hormel Packing Plant in Austin, Minnesota, determined to anesthetize its animals before killing them. It is done by the simple trick of running the hogs through a chamber of carbonic acid gas, in which way ten thousand daily go to sleep. This eliminates the fear of the runway and the pain of the sticking process; even as the efficiency of the butcher is enhanced by being given operation upon a quiet instead of a struggling hog suspended from a chain by a back leg. It has been claimed that precedent pain and fear affect the taste of meat. This item obviously is now controlled; and legs are no longer broken and hams bruised. It costs less to kill an animal in this humane fashion than it costs to do it in the customary; and it is more than a commercial plug when those who must eat meat—and those who can think—are asked to specify "Hormel."

Man has conquered the living world because he has learned the art of domestication, not only of himself but of many other animal forms. But is his prowess justified? It was in pioneer days and when man was seeking to live against a hostile world. But is it now? One of my conscientious friends is against the hunting of quail. Why will he then eat chicken, its close relative? His answer is simple—the quail works to live; the chicken only loafs. While the wild bird must fight eternally to gain subsistence, the barnyard bird, like the human "gold-digger," needs only to walk to the trough, keep breathing, and eat and swallow. It is not pure humor when our friends of the wild seek government aid to declare our ground fowl songbirds, so to shield them from the hunter.

It is not likely that any vivisector will ever be convicted so long as the public knows the blessing is vivisection has brought to the living world. Because of Claude Bernard, for example, we know the why of the flush, the why of the tear and the why of sugar in the urine. Through his experiments on frogs he invented the drug-testing techniques of today which allow us to know what a medicament will do before it is risked upon a patient. (Upon his death, his daughter threw all her energies and all her capital into the *anti*vivisection cause!) Because of Pavlov we know of the bridge between the body and the "psyche." Because of Cannon we know that no animal in pain, forgotten, caged, hungry or in fear reacts "normally."

How to manage a physiological laboratory is exhibited in Gustav Eckstein's reports on his animals (*Lives, Canary, Everyday Miracle*). His many canaries have always flown free, some of them living to be more than twenty years old. Pigeons prefer his working laboratory to the outside; the parrots are attached to him as persons; the turtles come to him to be buried for the winter. His cats have lived for years in common quarter with mice and rats—neither practicing cannibalism because adequately fed.

There comes great reward in biological discovery to the animal experimenter who understands Steinbeck's line: "Be kind to little dogs, you dirty man!"

Bulletins

Following are listed a number of recent bulletins of varied interest and noted here in the hope that they will be helpful to some readers.

"Marine Tropicals" by Ed. L. Fisher, is a 56-page booklet explaining a new and successful method for maintaining the brilliantly colored marine fish and animals. Available from Sub-Marine Studios, 918 Langford Building, Miami, Florida for $1.50. . ."How to Grow Longleaf Pine" by H. H. Muntz is Farmers' Bulletin 2061 of the U. S. Department of Agriculture, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 15 cents in coin. . ."Guarding Ohio's Water" is a description of Armco Steel Corporation's (Middletown, Ohio) activities in water conservation and pollution abatement. . ."Social Feeding Behavior of Birds" by Austin L. Rand is the latest bulletin of the Chicago Natural History Museum. $1.00. . ."Air Laboratories" by Verne N. Rockcastle and Eva L. Gordon is Vol. 47, No. 2, in the Cornell Rural School Leaflet Series. . ."Rural Poems," " "Songs of Arcadia" and "Book of Songs" are collections of poems by Otis Hite published by Rayburn's Ozark Guide Press, Eureka Springs, Arkansas. No price is given. . ."Agencies of the Federal Government Concerned with Recreation' discusses trends, inadequacies and needs, and is published by the National Recreation Association 315 Fourth Avenue, N. Y. 10, N. Y. at $1.00.

Honeybees

The World of the Honeybee. By Colin G. Butler. New York. 1954. The Macmillan Company. 226 pages. Illustrated. $4.50.

This book was first published in England, where the author is head of the Bee Department at Rothamsted Experimental Station. It was published as one of the volumes in the New Naturalist series. It is an able and thorough discussion of this much-written-about social insect, fully illustrated.

Animal Courtship

Animal Courtship. By Maurice Burton. New York. 1954. Frederick A. Praeger. 267 pages. Illustrated. $4.00.

The author of this book is Deputy Keeper of Zoology at the British Museum of Natural History and a writer, lecturer and broadcaster on natural history subjects. In this book he has assembled much fascinating, some surprising, and a great deal of interesting information on the sexual behavior of animals. He discusses relationships that range all the way from the praying mantis, who eats her spouse, to the female rook, who attracts a mate by baby talk; from the kissing of elephants to the male parental tasks of the seahorse.

MAN AND THE COLUMBIA'S SALMON

(Continued from page 37)

ways and means of facilitating and safeguarding fish migration. The Fish and Wildlife Service at its Seattle Laboratory is experimenting, for example, with electronic devices to control fish movements. It has already demonstrated that, under certain conditions, fingerlings subjected to pulsating direct current tend to move toward the positive electrode—a physiological phenomenon that might lead to the development of an electronic screen to prevent downstream migrants from being swept into irrigation canals and other water diversions.

Biologists are also testing other stimulus-producing equipment that might be useful in guiding or faciliating fish passage over high dams. Studies under way include the effect of underwater sound waves and light waves on fingerling movements; the effect of pressures in turbines and spillway jets on young fish.

In the past science has yielded unexpected solutions to baffling natural resource problems. Ingenious fish ladders, electronic guides, artificial propagation (now conducted on an immense scale in the Pacific Northwest), relocation of some races, reopening and improvement of spawning streams (a field in which federal and state governments have been quite active)—all these may offset part or most of the losses that will probably occur when the Columbia River is fully harnessed for such multiple purposes as power, irrigation, flood control, navigation and other benefits.

STRANGE IS THE KIWI

(Continued from page 43)

throughout New Zealand. They were caught in large numbers by the early Maoris, who lured them to destruction by imitating their peculiar whistling cry in the bush at night, and hunted them with their dogs in the daytime. The flesh was used for food and their feathers for making the kiwi cloaks.

But the Maoris were not wholly to blame for the diminution of these birds. Early settlers, bushmen and gold-seekers hunted kiwis with dogs. Blazing torches were carried at night to dazzle the dark-loving birds and make them easy victims. Large numbers of these inoffensive and particularly defenseless creatures were slaughtered in this way in the 1800's. One white man stated that, with the aid of two dogs, he used to catch from fifteen to twenty kiwis every night in the mountains near Nelson.

Miners used to speak appreciatively of kiwi pie, as if it was a favorite and familiar dish. They used the leathery skins for caps and the leg-bones for pipe-stems, while muffs made of the softly-feathered skins of the little gray kiwi were much in demand among white women in the new colony.

In those early days kiwi eggs were also in great demand by both Maoris and white settlers. But despite the early ravages of kiwi hunters, present-day hazards from dogs, wild cats, weasels and ferrets, combined with their flightless and almost blind condition, kiwis manage to maintain themselves in fairly large numbers in the more isolated parts of New Zealand, and on Stewart Island, as well.

Scientific investigators believe the kiwi to be of ancient origin. It is thought that, at one period in the history of its genus, the kiwi more nearly resembled ordinary birds, and possessed many of their more important distinctive features and outstanding characteristics. But during an age-long period of evolution it developed along different lines to suit special conditions connected with a changing environment, feeding habits, lack of natural enemies and so on. It is now most nearly allied to the giant emu-like moa, but differing from that extinct bird in many important respects.

Pictures of these famous flightless birds of New Zealand have been used so extensively on postage stamps, coins, in heraldry, as insigna for various clubs, and even as trade marks for a variety of products, that the kiwi has become New Zealand's national emblem.

CAMERA TRAILS

(Continued from page 49)

out the country.

Purpose of the department is to promote the increasing use of the finest Nature photographs by newspapers, magazines, book publishers, and others, through the sale of one-time reproduction rights to such material at "going-rates."

The department will act as agent for the photographer and will, of course, charge an agent's fee for its services. It will accept for marketing both black-and-white prints and color transparencies. There are, however, definite specifications to be met and arrangements to be made. To list them all would take more space than is available here. Any "Camera Trails" readers interested in the project should write direct to Miss Segnitz at the address given above for additional information.

May the New Year be a happy, productive, and photographic one.

For the Trail

Appearance of "Hiking, Camping, Mountaineering and Trail-Clearing Equipment" in its eighth edition testifies to the popularity and value of this publication of the Potomac Appalachian Trail Club. The bulletin was originally brought out in response to requests for advice on trail-going equipment, and most of the data given are based upon actual tests on the trail made by members of the organization. Copies are available for fifty cents from the Club at 1916 Sunderland Place, N. W., Washington 6, D. C.

Forestry Honors

At the 54th annual meeting of the Society of American Foresters two of the forestry profession's highest awards were announced.

To William L. Hall of Hot Springs, Arkansas, went the Gifford Pinchot Medal. Mr. Hall was co-founder with Mr. Pinchot of the Society, is owner and manager of extensive producing timberlands in Arkansas, and, at 81, the oldest professional forester in America in active practice.

To Tom Gill of Washington, D. C., went the Sir William Schlich Memorial Medal, named for one of the most eminent foresters of the English-speaking world. Dr. Gill is executive director of the Charles Lathrop Pack Forestry Foundation, and he was awarded the medal for distinguished service to international forestry. He has been a forestry consultant to several governments in Central America and the Orient, and is a special forestry adviser to the Food and Agricultural Organization of the United Nations.

Bird Names

"Longevity of Bird Names" is the title of an article by Waldo Lee McAtee, recently published in *Names*, the journal of the American Name Society, University of California Press, Berkeley 4, California. The article traces the folk-names of our birds through the centuries. Copies of a reprint of this paper are available at the address given, in return for ten cents in coin or stamps.

Expeditions

Zoo Expeditions. By William Bridges. New York. 1954. Williams Morrow and Company. 191 pages. Illustrated. $3.00.

Among the many expeditions undertaken in behalf of the New York Zoological Society and the Bronx Zoo, Bill Bridges, curator of publications for the Society, has chosen seven to describe in this book. He took part in all seven of them. Most of the expeditions take the reader far afield, but one is devoted to the matter of the oldest turtle, a story that James A. Oliver told in the February, 1954 issue of *Nature Magazine*.

Snow

Snow. By Thelma Harrington Bell. New York. 1954. The Viking Press. 56 pages. Illustrated by Corydon Bell. $2.50.

Anyone who takes snow as a matter of course is ignoring one of the most fascinating and beautiful of the phenomena of weather. From the beauty of the individual flake to the formation of glaciers, snow is an alluring study. In this book, with its fine illustrations, the author tells, within brief compass, the whole story of snow.

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UNDER THE MICROSCOPE

By JULIAN D. CORRINGTON

OPTICAL ILLUSIONS

Part II

LAST month we brought up for discussion a number of instances in which the eye fools the mind, as people say, then went on to explain that the eye is not at fault. Our organ of vision reports to the brain what it sees, but the mind places an incorrect interpretation on this report, often because of the strong influence of past experience.

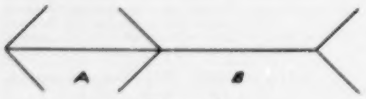

Figure 1

Let us reconsider the first illustration, from the December issue *(*fig. 1*)*. This is perhaps the best known of all geometrical space illusions, and is known to psychologists as the Müller-Lyer illusion. The two vertical lines are of the same length, although all normal adults, and children old enough to tell us what they see, perceive one line as considerably shorter than the other. Moreover, discrimination experiments with animals, notably with chickens, in which the subject is rewarded with food if it approaches a long line, but punished with electric shocks when nearing a short line, show that the Müller-Lyer lines are perceived as different in length by birds, too. Thus it is an example of a basic, inborn phenomenon termed *primitive organization*, and is not something acquired by experience.

Explanations have been numerous, but none completely convincing. Some hold that eye movements, following the vertical lines, tend to continue along the divergent oblique lines, but to be arrested short of the terminus on meeting the retrograde lines. These movements, too far in one case, too short in the other, affect neurons in the brain to produce the perceptual illusion. Other psychologists believe that we read ourselves into the picture; in one case there is room to expand, in the other the space is cramped.

Another primitive organization is the *phi-phenomenon* illusion of motion where none occurs, and our illustration was the motion picture. Here a single still picture is flashed on the screen and seen by the observer, then a shutter cuts across the projection beam and produces total blackness while the next picture is moving into place. It is slightly different from the preceding frame, as in the posture of actors. When the shutter opens and this second picture is seen, and so on through a succession of slightly different depictions of the subject, at such a rate as to reduce the flicker to an unobjectionable degree, the subjects appear to move smoothly and continuously through one position after another. Actually, of course, the pictures do not move at all, but because the movements within the organism of the observer—eyeballs for example—and relaying of sensory impressions from neuron to neuron, and their interpretations in consciousness, in devious ways as yet unexplained, the pictures *seem* to move. After-image was at first thought to be a satisfactory "explanation," but is now seen to be unable to account for the apparent movement.

Some of the other illusions presented last month, as the perspective view of the sidewalk and wall, receding into the distance, but the lamp posts purposely all drawn to the same height, and appearing as successively taller, depend on experience and training and are not innate.

The eyes may be educated to do many unusual things, and present us with illusions of interpretation. Acquiring a vacant expression might seem a socially undesirable accomplishment, but it can be useful for experimental purposes. It is not at all difficult to learn to relax the accommodation of the lenses of the eyes so that, while the gaze is trained on a near object, the focus slips to the far point of distant vision. A little practice will enable you to look at a stereoscopic picture without the instrument, perhaps at first with the help of a card held vertically between the eyes to separate their visual paths, later without even this, and, by relaxing the accommodation, see the two pictures as one, with stereoscopic effects. Easiest way to achieve this capacity quickly is to center the attention on a distant object, then, without changing this relaxed accommodation, place the stereoscopic pictures suddenly before the eyes, about one foot distant.

In microscopy, this facility will come in handy in making drawings. Although we train the mind so that the image from the "unused" eye does not record, it is perfectly easy to reverse this training at any desired moment, gaze down the tube of the microscope at the specimen on the slide with the left eye, and, relaxing the accommodation, with the right eye see a pencil point we are moving on a sheet of drawing paper alongside the base of the instrument. The fusion image that can result sees the point of the pencil traveling among the parts of the specimen, and enables the operator to sketch in proportions and main features of the subject, as if he were using a camera lucida. This ability sounds fantastic, but can be acquired with only a small bit of practice.

Robert Smith's illusion *(*1738*)* is pertinent here as showing the way binocular vision normally functions. As described in Southall's *Introduction to Physiological Optics*, a pair of dividers is held vertically before the eyes, about one foot away, points up and some three inches apart. Now look between the points at some object across the room, or outdoors. Two images of the dividers will be seen, the two center legs intersecting near their tips. Slowly close the tips until these two central images fuse into one; this will be at a point where the distance between the two tips is somewhat less than the interpupillary distance. The center of three legs is now seen distinctly to be a dagger-like shaft that extends all the way to the object of your gaze. We have added to the effect of this illusion by pulling the base of the dividers in so as to rest on the tip of our nose, meanwhile tilting the tips forward, and securing the weird effect of seeing a pencil-like shaft of metal extending all the way from our nose to a gatepost a hundred yards away! Smith explained his own illusion by stating that when the adjustment is exactly right between the two tips their retinal images coincide with the images of the point of fixation in the two eyes.

Space illusions, with or without apparatus, are all designed to take advantage of the normal and habitual way in which our eyes have trained our minds. Most confusing is the experimental room in which the angles, slopes, and distances are all unorthodox. Recent magazine articles have presented several photographs of distorted experimental rooms. Seen at close range, the mind rejects the distortion and perceives the room as normal, because of the past experience that all rooms are rectilinear, and regards the tilted objects in the room as abnormal. At a greater distance, where the room as a whole can be viewed from without *(*the wall facing the observer is missing*)* the true state of affairs becomes immediately apparent. This experiment, devised by Professor Ames, is being used to demonstrate that vision and perception are two different things. Vision is the mechanical reception of images by the eye; perception is the accompanying series of mental processes. The eye reports what is to be seen, but the mind interprets these reports in terms of customary experiences. It is hence easy to set up experimental conditions that completely delude perception.

In our past experience we have learned that, of two or more like objects, the larger ones are nearer; that if one object overlaps another it is the closer of the two; linear perspective, as of receding railroad tracks, and aerial perspective, which is clearness of detail of an object as opposed to haziness—all of these are clues to depth perception. The retinal image has no depth, but the mental perception acquires this ability to estimate distance with experience.

Conceptions of motion can yield some fascinating illusions. When we are traveling by train and looking out the

window, we seem to stand still while the scenery flashes past. Analyzing the appearances more closely; nearby objects, as telephone poles, dash past us in the opposite direction to that we are going, but distant objects travel with us. When we are in the station and the train on the adjoining track starts up, we are certain that it is our train that has resumed motion, since our mind has been so conditioned.

The stroboscope is an appliance to analyze motion. Suppose we have a rotating disc with a slot, and we can look through this slot whenever it is in the twelve o'clock position and observe the spokes of a wheel of a moving vehicle. If the speeds of disc and wheel are the same, then every time the slot in the disc reaches the point opposite our eye, a spoke of the wheel also comes to the top position, the wheel appears to be standing still. Just as in the movies, we are not conscious of perceiving separate pictures. We see always a spoke in the same position; no motion is apparent, and we have "stopped" the movement of the wheel. So, also, whenever disc speed is a multiple of spoke speed, or when the slot arrives opposite our eye while the turning of the wheel brings the next spoke into the viewing position, the wheel seems motionless. But if now the disc's speed is increased a trifle, the slot will arrive at the viewing spot ahead of the wheel spoke. For each revolution of the disc the spoke is a bit farther back, and so the wheel will appear to us to be turning backward, even though common sense, experience, or other sensory impressions assure us that it is turning forward. In this same manner, water from a faucet, strongly illuminated and viewed through a stroboscope, can be made to appear flowing upward, into the faucet. This sort of thing is a real optical as well as mental illusion. We are here employing a machine to conceal the actual state of affairs and present to the eye a partial picture that perpetrates a fraud.

Color illusions are well known to all interior decorators and artists. Paint a room all one solid color, walls and woodwork alike, if you wish it to appear larger than it is; break it up to make it seem smaller. Paint or paper it in long-wavelength hues, as red, to keep it small; in short-wavelength colors, as violet, to make it appear more spacious. If you have pigments available, as oils or water-colors, try this one—a red spot on a violet background appears raised, but a violet spot on a red background seems depressed. Complementary colors can work some curious illusions. We once played billiards for several hours, then were startled to find the night sky, when we left the building, of a reddish hue. We had been saturating our vision all evening with green, the complement of red, by gazing for too long a time at the billiard table.

Luminosity and brightness contrasts yield some interesting illusions. Hering devised a series of seven cardboard rectangles ranging from white through five shades of gray to black. In the center of each was placed a small circular disc of medium gray, of the same intensity as the central disc, and all alike. But by contrast, the gray disc on the black card looks very much lighter than that on the white card, so much so that it is not possible to convince the observer that the two gray discs on the terminal cards, the black and the white, are the same; they look utterly different. We made a mask that permitted seeing only the row of discs; when applied to the exhibit, the discs at once appeared of a uniform gray. Also, in this illusion, the disc on the central card, being identical in hue with its background, should be invisible but is not; a disc distinctly darker than its background is "seen."

Hermann made a white grating on a black ground. In the example before us (Southall, p. 401), the sixteen black squares are each approximately one-half inch wide and arranged as a checkerboard of four squares on a side. The intersecting white spaces are only one-sixteenth inch wide. As one looks at this figure he becomes aware that the intersections contain gray diamonds that disappear when gazed at directly; they are seen out of the corner of the eye and result from contrast, although the full explanation of the reason for these contrast illusions is not yet forth coming. Our figure 2 is the same in principle, but we have not blackened the squares. In spite of this we nevertheless see evanescent gray diamonds at the intersections after staring at the figure a moment. We chase them around, but never see the one we look at directly. This illusion would seem, then, to present something other than contrast, which is lacking here.

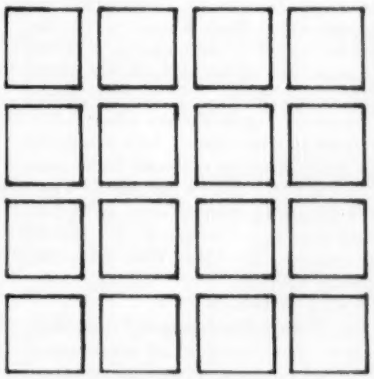

Figure 2

The real *optical* illusion is something very different from the many perceptual illusions we have presented in these two articles. The eye itself is tricked by the arts of nature or man. In the first class will come mirages, rainbows, and similar phenomena in which the normal at-

mospheric effects on the radiation, absorption, reflection, refraction, and diffraction of light are altered by local conditions, as currently discussed in our series on *Meteorological Optics*. In the second class can be placed those tricks of the professional magician that take advantage of optical laws and properties.

We are all well aware of the fact that a sheet of polished plate glass, as a store front, can either transmit light so that we see the contents of the window, or reflect objects in the street, including our own image, according to the direction of incident light rays and that of our gaze. So, on the stage, an inclined plate glass, with edges concealed from the audience, can be so illuminated as to be completely invisible. On one side of it may be a tank of water, on the other a "mermaid" apparently in the water but actually outside the tank, and thus able to remain "submerged" indefinitely. A "severed" head may seem to rest on a glass-topped table and be able to eat, smoke, or converse. Many variations of such tricks are possible, employing regular reflection, total internal reflection, critical angle, and other optical laws, along with special backgrounds and lighting effects to delude the viewer.

Truly, seeing is believing, but we should not believe all we see.

SCIENCE SHOPS

6. Quivira

AMONG the newer biological supply houses in America is one that grew, as have many others, from a one-man collecting enterprise. The Quivira Specialties Company, of Topeka, Kansas, was founded in 1938 and is owned by Charles E. Burt, Ph.D., and May D. Burt, B.S., Charles being the manager. The Company carries a rather full line of living and preserved material, supplies, and equipment, but specializes in herpetology (amphibians and reptiles) and entomology.

The history of this firm to date is largely the personal history of the founder, Dr. Burt. A native of Neodesha, Kansas, he received his B.S. from Kansas State College in 1926, and the M.S. in 1927. Securing a fellowship, he attended the University of Michigan, where he took his Ph.D in herpetology in 1930. In 1929-30 he was Assistant Curator of Herpetology at the American Museum of Natural History, New York, then went to Trinity College in Texas, 1930-31, as Professor of Biology. Next came his most important teaching position, Professor and Head of the Biology Department at Southwestern College, Winfield, Kansas.

Summertimes Dr. Burt took part in collecting expeditions for herpetological specimens—for Michigan to the southwestern U. S. in 1928; for the American Museum to the mid-western States in 1929; for the Smithsonian Institution to the southeastern U. S. 1932-35; for the University of Rochester to the Smoky Mountains in 1937. Burt has traveled in all of the 48 states and much of Canada and Mexico, and as a result knows many of the biological "garden spots" where collecting is at its best. As a further result he made many valuable contacts and finally acquired the collecting "bug" to such a degree that he decided to sell specimens to the larger supply houses, a practice that has continued. The retail business began in 1938. In 1944, however, the tail began to wag the dog, and so Dr. Burt left the teaching profession to devote full time to his growing business.

A note in their catalog explains the name: "Certain Mid-West Indian villages of some 400 to 500 years ago were named 'Quivira.' By general usage Quivira (or Quivera), like Jayhawk, has become a synonym for Kansas." The Company issues a general catalog and special lists. The current catalog is number 19 and consists of 36 pages, fully illustrated; the principal sections are living specimens, dry and preserved specimens, microscope slides, laboratory supplies and apparatus, and publications, including both magazines and books, of the latter of which several hundred are listed. Certain curios and collectors' items close the selections.

You can buy a living Ant Colony, complete with queen, for $3.75 and an Ant Home in which to keep them for $2.75. There are as many as three columns of entries of aquariums and supplies for maintaining them. Snakes are sold by length, in six-inch or twelve-inch increments; for example, live rattlers designated as "fresh and dangerous" and shipped either from Kansas or Florida, will set you back two bucks per foot, but a whole den of small harmless species costs only $3.00. A healthy young Cinnamon Ringtail Monkey brings $40.00, whereas a large horned toad retails for one dollar, and you can order 35 Mexican Jumping Beans also for one dollar. Fourteen listings are items to serve as food for other animals. The address is: Quivira Specialties Co., 4204 West 21st St., Topeka, Kansas.

TESTA MOVES

The Testa Manufacturing Company, makers of microscopes and other optical items frequently noted in these columns, has a new address: 10130 East Rush St., El Monte, California. These are newer and larger quarters, not far from their old location.

LIBRARY CORNER

Aquatic Microscopy

A new guide to the study of pond life is a rarity and is thus a red-letter item for the microscopist. This one comes from England, but the organisms treated know no national boundaries and are equally abundant in American waters and the ones the collector and student will wish to know, wherever he may be. The author, W. J. Garnett, is eminently qualified as a lifelong student of the subject as well as head of one of the largest firms manufacturing and dealing in microscopes and prepared slides (Science Shops, this Department, Aug.-Sept., 1953). His pen and camera have been equally busy in *Freshwater Microscopy* to present information on all the commoner denizens of ponds and streams, both plant and animal, and the combination is most effective. All but a few of the photomicrographs are excellent and the text describes collecting, mounting, and study of the live specimens from personal experience.

Three introductory chapters discuss collecting, equipment, and examining the catch. Then follow four chapters on plants, from algae through bacteria and fungi to higher water plants. Animal life requires seven chapters, from protozoa to insects, and there is a final one on making permanent mounts, followed by a bibliography, two appendices, glossary, and index. All students of the minute life of freshwaters will find this new work refreshing, well written, and indispensable. Pp. XII, 300; Plts., frontisp., L, with 226 photos and 6 drawings; 51 text figs. Constable & Co., Ltd., 10-12 Orange St., London, W. C. 2, England, 1953. 30 shillings.

General Zoology

A most interesting combination of the best in the older and newer methods of presenting the subject matter of general animal biology is encountered in *Zoology*, by Alfred M. Elliott, University of Michigan. There are seven Parts, beginning with an excellent orientation on "Zoology as a Science," including a bit of history. Part II takes up cells and life, III the organized animal, with tissues, organs, and systems. Part IV is a systematic evolutionary presentation of animal life, with chapters on ecology and taxonomy; V is human anatomy and physiology; VI deals with development and heredity; and VII with evolution. Appended material includes a comprehensive table of classification, annotated references, acknowledgments, glossary, and index.

This organization is in general the older, tried and proved plan. But the method of presentation is very new: the pages are wide, with a two-column format, and every point of emphasis (not merely headings) is in boldface type. It is the illustrations above all, however, that make this text unique. Dr. Elliott formerly issued certain of these as an envelope of sheets serving as an adjunct to other texts; now greatly augmented, they form the backbone of his own book. Mostly they are of the bold, diagrammatic or stereoscopic cartoon type of drawing that is very compelling and instructive, emphasizing certain aspects without sacrificing correctness of morphologic fact. And there are a great many of them, supplemented by photographs where these will serve best. We believe that both the teacher and the student will be very much intrigued by this new kind of text. Pp. x, 719; figs. 501. Appleton-Century-Crofts, Inc., 35 W. 32d St., New York 1, 1952. $6.00.

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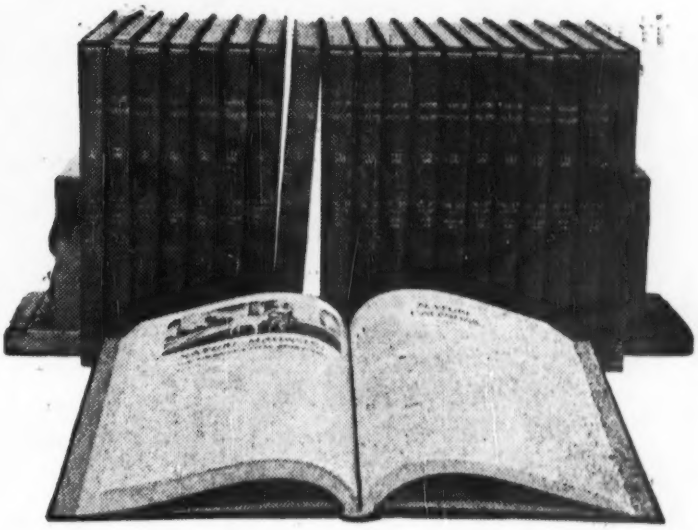

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the boy and the Star

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